HEWLETT® PACKARD

Operaring
and
Service
Manual

Model 3400A
RMS Voltmeter

ACQN

MANUAL CHANGES

-hp- MODEL 3400A

RMS VOLTMETER

Manual Part Number 03400-90013

CHANGE NO. 1. Applies to Serial Numbers 2415A31171 and Above.

Section VII, Table 7-3 (Replaceable Parts). Do the following changes in the table:

Reference Designation	HP Part Number	C D	Qty	Description
Change: C102	0121-0457	9	2	CAPACITOR-V TRMR-PSTN .8-8.5PF

CHANGE NO. 2. Applies to All Serial Numbers.

Page 1-3/1-4, Table 1-2 (Equipment Supplied). Change the -hp- part number of the power cord from "8120-1348" to "8120-1378."

CHANGE NO. 3. Applies to All Serial Numbers

Section V, Paragraph 5-8. Add the following note to the paragraph.

If in the following procedure the HP 3400A appears to be non-linear, it could be caused by ground loops. If this is noted, isolate the HP 3400A from the ac power line by using an isolation transformer between the ac power line and the Model 3400A.

CHANGE NO. 4. Applies to Serial Numbers 2415A31801 and Above

Section VI, Figure 6-1 (A1, A2, and A3 Schematic). Do the schematic changes in Figure 6-1 as shown in Figure CS-1 (in shaded area).

Figure CS-1. Figure 6-1 Changes (Change #4)

Section VII, Table 7-3 (Replaceable Parts). Do the following changes in the table:

Reference Designation	HP Part Number	C D	Qty	Description
Add:				
C301	0160-3402	2	1	CAPACITOR-FXD 1UF ±5% 50VDC POLYE
C306	0160-2259	5	1	CAPACITOR-FXD 12PF ±5% 500VDC CER
R313	0683-0335	2	2	RESISTOR 3.3K 5% .25W FC TC=-400/+800
R314	0683-0335	2		RESISTOR 3.3K 5% .25W FC TC=-400/+800

CHANGE NO. 5. Applies to All Serial Numbers.

Section V. Paragraph 5-13. The 410C Voltmeter called for in the Crest Factor Test has been discontinued. If a 410C Voltmeter is not available an oscilloscope may be used to set up the pulse trains. The pulses should have an amplitude of 10.1 Volts for a Crest Factor of 10, and an amplitude of 10.0 Volts for a Crest Factor of 20. These amplitudes require that the pulse widths and spacings given in steps c and e remain unchanged.

ERRATA

Section VI, Figure 6-1 (A1, A2, and A3 Schematic). Change the word "VIDIEO" to "VIDEO" at the AC INPUT point.

Section VII, Table 7-3 (Replaceable Parts). Change the check digit of CR402 from "3" to "1" and add a quantity of "1".

Section VII, Figure 7-5 (3400A Rear View). Change the -hp- Part Number of S2 in the table located in Figure 7-5 from "3103-1234" to "3101-1234".

CHANGE NO. 6. Applies to All Serial Numbers

Add the attached "Declaration" to the manual.

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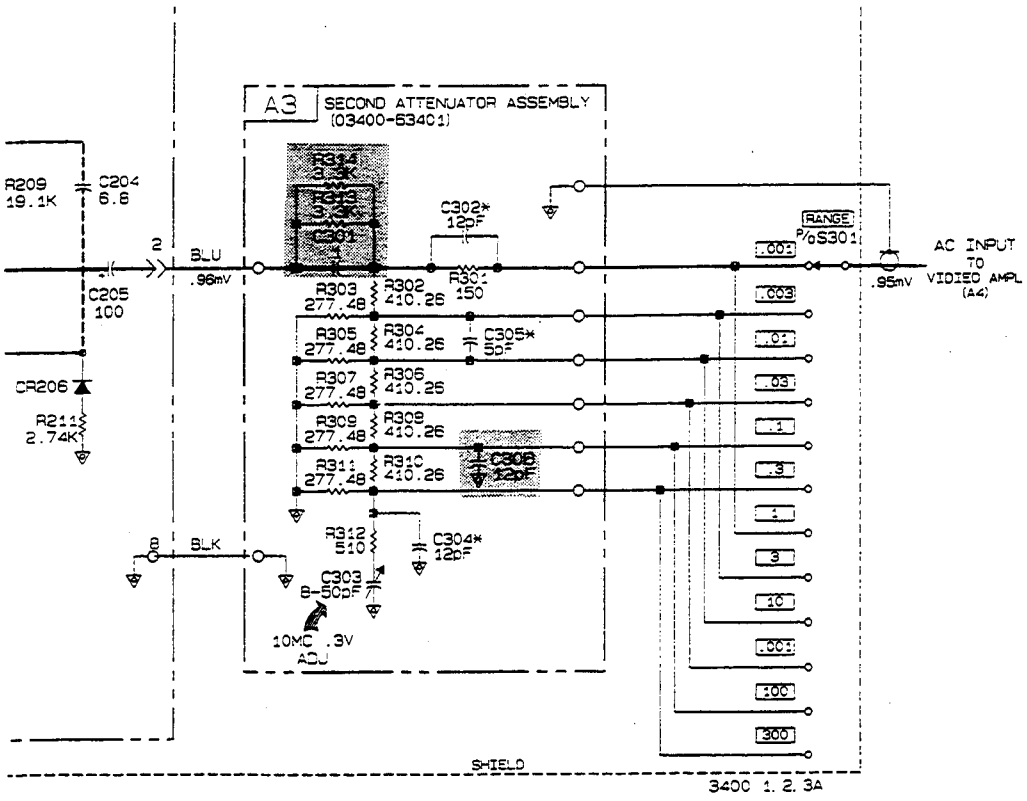

Figure CS-1. Figure 6-1 Changes (Change #4)

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Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System HP 3400A in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Meß- und Testgeräte

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's declaration

This is to certify that the equipment HP 3400A is in accordance with the Radio Interference Requirements of Directive FTZ 1046/84. The German Bundespost was notified that this equipment was put into circulation, the right to check the series for compliance with the requirements was granted.

Additional Information for Test- and Measurement Equipment

If Test- and Measurement Equipment is operated with unscreened cables and/or used for measurements on open set-ups, the user has to assure that under operating conditions the Radio Interference Limits are still met at the border of his premises.

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OPERATING AND SERVICE MANUAL

MODEL 3400A
RMS VOLTMETER

SERIAL NUMBERS

This manual applies directly to instruments with a serial number prefix of 2415.

WARNING

To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excessive moisture.

Manual Part Number 03400-90013
Microfiche Part Number 03400-90063

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CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the National Institute of Standards and Technologies, to the extent allowed by the the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in materials and workmanship for a period of one year from date of shipment [,except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period]. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

Duration and conditions of warranty for this instrument may be superceded when the instrument is integrated into (becomes a part of) other -hp- instrument products.

Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT OPERATE A DAMAGED INSTRUMENT

Whenever it is possible that the safety protection features built into this instrument have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the instrument until safe operation can be verified by service-trained personnel. If necessary, return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

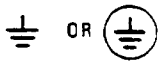
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

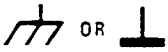
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE: The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This section contains general information about the Model 3400A RMS Voltmeter (Figure 1-1). Included are: description of instrument, purpose, instrument identification, equipment supplied and accessory equipment available. Also included is a table of instrument specifications.

1-3. DESCRIPTION AND PURPOSE

1-4. The Model 3400A RMS Voltmeter measures the actual root-means-square (RMS) value of ac voltages between 100 microvolts and 300 volts. Frequency range is from 10 Hz to 10 MHz. Full scale measurements of nonsinusoidal waveforms with crest factors (ratio of peak voltage to rms voltage) of 10 can be made.

1-5. Ac voltages are measured with a specified full-scale accuracy of ±1% from 50 Hz to 1 MHz, ±2% from 1 MHz to 2 MHz, ±3% from 2 MHz to 3 MHz, and ±5% from 10 Hz to 50 Hz and 3 MHz to 10 MHz. A single front panel control selects one of 12 voltage or decibel ranges.

1-6. The Model 3400A crest factor rating is 10:1 which enables full scale readings for pulses which have a 1% duty cycle. At 1/10th of full scale, pulse trains with 0.01% duty cycle (100:1 crest factor) can be accurately measured.

1-7. The Model 3400A provides a dc output which is proportional to the front panel meter reading. By using this voltage to drive auxiliary equipment, the Model 3400A functions as an rms ac-to-dc converter.

1-8. SPECIFICATIONS

1-9. Table 1-1 contains the specifications for the Model 3400A.

1-10. INSTRUMENT AND MANUAL IDENTIFICATION

1-11. Hewlett-Packard uses a two-section serial number. If the first section (serial prefix) of the serial number on your instrument does not agree with those on the title page of this manual, change sheets supplied with the manual will define the differences between your instrument and the Model 3400A described in this manual. Some serial numbers may have a letter separating the two sections of the number. This letter indicates the country in which the instrument was manufactured.

1-12. EQUIPMENT SUPPLIED

1-13. The equipment supplied with each Model 3400A is listed and described in Table 1-2.

Table 1-1. Model 3400A Specifications

VOLTAGE RANGE: 1 mV to 300 V full scale, 12 ranges.

DB RANGE: -72 to +52 dBm (0 dBm = 1 mW in 600Ω).

FREQUENCY RANGE: 10 Hz to 10 MHz.

RESPONSE: Responds to rms value (heating value) of input signal.

METER ACCURACY:* from 1/10 scale to full scale is % of Full Scale (20°C to 30°C)**

10Hz	50Hz	1MHz	2MHz	3MHz	10MHz
±5%	±1%	±2%	±3%	±5%	

AC-to-DC CONVERTER ACCURACY: % of Full Scale (20°C to 30°C)*

10Hz	50Hz	1MHz	2MHz	3MHz	10MHz
±5%	±0.75%	±2%	±3%	±5%	

OUTPUT: Negative 1 V dc into open circuit for full-scale deflection, proportional to meter deflection; 1mA maximum; nominal source impedance 1000Ω.

OUTPUT NOISE: < 1 mV RMS.

CREST FACTOR: (ratio of peak-to-rms amplitude of input signal): 10:1 at full scale (except where limited by maximum input), inversely proportional to meter deflection (e.g., 20:1 at half-scale, 100:1 at tenth-scale).

IMPUT IMPEDANCE 0.001 V to 0.3 V range; 10 MΩ shunted by < 50 pF: 1.0 V to 300 V range; 10 MΩ shunted by < 20 pF. AC-coupled input.

AC OVERLOAD: 30dB above full scale or 800 V peak, whichever is less, on each range.

MAXIMUM DC INPUT: 600 V on any range.

RESPONSE TIME: For a step function, < 5 seconds to respond to final value.

POWER: 115 or 230 V ±10%, 48 to 440 Hz. approximately 7 watts.

WEIGHT: Net 7 1/4 lbs. (3, 3kg); shipping 10 lbs. (5kg).

OVERALL DIMENSIONS: 6 1/2" high; 5 1/8" wide; 11 11/16" deep.

STORAGE TEMPERATURE: −10°C to +60°C.

* The 3400A may show a zero offset with no voltage applied to the input terminals.

** Temperature Coefficient: ±.15%/°C over range of 0°C to 20°C and 30°C to 55°C.

Figure 1-1. 3400 RMS Voltmeter

1-14. ACCESSORY EQUIPMENT AVAILABLE

1-15. The accessory equipment available is listed in Table 1-3. For further information contact your local -hp- Sales and Service Office.

Table 1-2. Equipment Supplied

Identification Number	Quantity	Description
10110B	1	Adapter (BNC to dual banana jack)
8120-1348	1	Power Cord
03400-90011	1	Operating and Service Manual

Table 1-3. Accessory Equipment Available

Identification Number	Description
10503A	Cable (Male BNC to male BNC, 48 inches)
11001A	Cable (Male BNC to dual banana plug, 45 inches)
11002A	Test Lead (dual banana plug to alligator clips, 60 inches)
11003A	Test Lead (dual banana plug to probe and alligator clip, 60 in.)
456A	Current Probe

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information and instructions necessary for installation and shipping of the -hp- Model 3400A RMS Voltmeter. Included are initial inspection procedures, power requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION

2-4. The -hp- Model 3400A RMS Voltmeter received a careful mechanical and electrical inspection before shipment. As soon as the Model 3400A is received, verify that the contents are intact and as ordered. Although the instrument should be free of mars and scratches and in perfect electrical condition, it should be inspected for any physical damage which may have been incurred in transit. Also test the electrical performance of the instrument using the procedures given in paragraph 5-5. If any physical damage or electrical deficiency is found, refer to the warranty on the inside front cover of this manual. Should shipping of the instrument become necessary, refer to paragraph 2-14 for repackaging and shipping instructions.

2-5. POWER REQUIREMENTS

2-6. The Model 3400A can be operated from any ac source of 115- or 230- volts (± 10%), at 48 to 440 cycles. With the instrument disconnected from the ac power source, move the slide switch (located on the rear panel) until the desired line voltage value appears. The ac line fuse is a 0.25 amp, fast blow type for 115- or 230-volt operation. Power dissipation is approximately 7 watts.

2-7. The Model 3400A is equipped with a three-prong power cord. To protect operating personnel, it is necessary to preserve the grounding feature of this plug when using a two contact ac outlet. Use a three-prong to two-prong adapter and connect the green pigtail lead on the adapter to ground.

2-8. INSTALLATION

2-9. The Model 3400A is a submodular unit suitable for bench top use. However, when used in combination with other submodular units it can be bench and/or rack mounted. The -hp- combining case and adapter frame are designed for this purpose.

2-10. Combining Case (-hp- Models 1051A or 1052A)

2-11. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-12. Adapter Frame (-hp- Part No. 5060-0797)

2-13. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp-Sales and Service Office.

2-14. REPACKAGING FOR SHIPMENT

2-15. The following paragraphs contain a general guide for repackaging for shipment. Refer to paragraph 2-16 if the original container is to be used; 2-17 if it is not. If you have any questions, contact your local -hp- Sales and Service Office.

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-16. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that the container is well sealed with strong tape or metal bands.

2-17. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Use packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION

3-2. This section consists of instructions and information necessary for the operation of the -hp- Model 3400A RMS Voltmeter. This section contains identification of controls and indicators, turn-on procedures, and operating instructions. Also included is a discussion of the applications for the Model 3400A.

3-3. CONTROLS AND INDICATORS

3-4. Each operating control, connector, and indicator located on the Model 3400A is identified and described in Figure 3-1. The description of each component is keyed to an illustration of that component which is included within the figure.

3-5. TURN ON PROCEDURE

3-6. To turn on the Model 3400A, proceed as follows:

a. Set 115/230 switch (7, Figure 3-1) to correct position for input line voltage.

b. Apply ac voltage to Model 3400A by plugging power cord into input power jack (8) ac receptacle.

c. Operate power switch (4) to ON; ensure that LINE indicator (3) lights.

NOTE

Allow five minutes for the Model 3400A to warm up and stabilize before making a reading.

3-7. OPERATING INSTRUCTION

CAUTION

Do not measure signal above 80 volts with 10 to 1 crest factor. Otherwise, the maximum input rating (800 volts peak) will be exceeded. When measuring signals up to 80 volts RMS with a 10 to 1 crest factor, use the BNC to dual banana jack, accessory 10110A, supplied with the instrument, or other input test leads and connections that will withstand the maximum input of 800 volts peak.

3-8. To operate the Model 3400A as an rms voltmeter proceed as follows:

a. Attach test lead to INPUT connector (6, Figure 3-1). (See Table 1-3 for a list of test leads available.)

b. Set RANGE switch (5) to 300 VOLTS position.

CAUTION

When measuring an ac signal superimposed on a DC level, always set the range switch to the 300 volt position. A high voltage transient due to the application of a DC voltage will damage the input circuitry.

c. Connect test lead to point to be measured.

d. Rotate RANGE switch counterclockwise until meter (1) indicates on upper two thirds of scale.

3-9. APPLICATIONS

3-10. The Model 3400A can be used in conjunction with other test instruments to measure the rms value of ac signal with a dc component, measure rms current and act as an rms ac-to-dc converter. For additional information on special applications, contact your -hp- Sales and Service Office.

3-11. RMS Value Of AC Signals With DC Component

3-12. Since the 3400A is an ac device it will measure only the rms value of the ac component. If it is necessary to include the rms value of the dc component when measuring a signal use an -hp- Model 3468A Digital Multimeter to measure the dc component. Substitute the reading from the Model 3468A and Model 3400A in the following formula: The ac signal (up to 800V peak) may be superimposed on a dc level of up to 600 V.

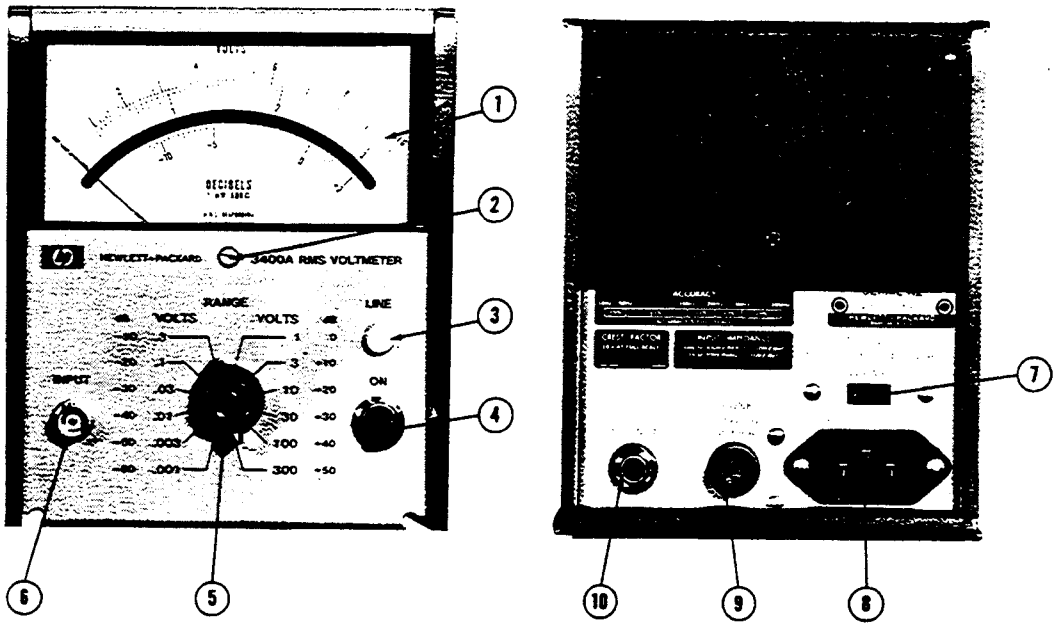
$$e_{rms} = \sqrt{e_{ac}^2 + e_{dc}^2}$$

3-13. RMS Current

3-14. To measure rms current, use an -hp- Model 456A AC Current Probe. This probe clips around the current conductor and provides an output voltage that is proportional to the current being measured. Using this method, rms currents of one milliampere to one ampere can be measured.

3-15. RMS AC-To-DC Converter

3-16. Since the Model 3400A is provided with a dc output (10, Figure 3-1) which is proportional to the meter deflection, it can be used as a linear rms ac to dc converter. The dc output can be used to drive an -hp- Model 3468A Digital Multimeter for high resolution measurements and/or an -hp- Model 680 Strip Chart Recorder. External loading does not affect the meter accuracy so that both the meter and dc output can be used simultaneously. A plug for DC OUT jack may be purchased under -hp- Part No. 1251-0067.



1. Direct reading meter: dc meter which indicates rms voltage level of input signal.
2. Mechanical zero adjustment: screwdriver adjustment for zero of direct reading meter.
3. LINE ON pilot lamp: neon lamp which indicates when power is applied to instrument and power switch is ON.
4. Power switch: two-position toggle switch which applies 115- or 230-volts ac to instrument.
5. RANGE switch: 12-position rotary switch which selects various attenuation ranges available within Model 3400A.
6. INPUT connector: BNC jack which enables application of input signal to instruments measuring circuits.
7. 115/230-volt switch: two-position slide switch which sets instrument to operate from either a 115- or 230-volt ac source.
8. Input power jack: three-prong jack which enables application of line voltage to instruments power supply circuits.
9. 115V/230V .25A FUSE: 0.25 ampere fuse which provides protection against line voltage surges.
10. DC OUT jack: telephone-type jack which provides negative 1-volt dc out at full scale deflection, output is proportional to meter deflection. Output impedance is 1000 ohms.

A telephone plug for the DC OUT jack may be purchased under -hp- Part No. 1251-0067.

Figure 3-1. Model 3400A Controls and Indicators

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section contains the theory of operation of the Model 3400A RMS Voltmeter. Included is a general and detailed description of the theory of operation.

4-3. GENERAL DESCRIPTION

4-4. The operation circuitry of the Model 3400A consists of two attenuators, an impedance converter, a video amplifier, a chopper op amp, a thermocouple pair, and a direct reading meter.

4-5. A signal being measured with the Model 3400A is applied to input attenuator A1 through the INPUT jack, located on the Model 3400A front panel. The input attenuator has an input impedance of over 10 megohms and provides two ranges of attenuation. The output of the input attenuator is applied to impedance converter A2. The impedance converter is a non-inverting unity voltage gain amplifier. It presents a high impedance to the input signal and provides a low impedance output to drive the second attenuator A3. The second attenuator provides 6 ranges in a 1, 3, 10 sequence. The two attenuators are switched to provide 12 ranges of attenuation.

4-6. The output of the second attenuator is amplified by video amplifier A4. The video amplifier is a wideband, five stage amplifier. The overall gain of the video amplifier is controlled by an ac feedback loop. The ac output of the amplifier is applied to TC401; one of the thermocouples of the thermocouple pair.

4-7. The dc output of TC401 is applied to the chopper op amp (U601) which modulates the voltage. The resultant modulated signal is then amplified and, after the amplification, the signal is demodulated back to dc volts. This voltage is the output of the chopper op amp. The value of the voltage is proportional to the dc input voltage.

4-8. The output of the chopper op amp is applied to a filter and also to TC402, the second thermocouple of the thermocouple pair. The output of the filter is applied to an output amp (A4) which is used to drive the meter (M1).

4-9. The thermocouple pair TC401 and TC402 acts as a summing point for the ac output of the video amplifier (A4) and the dc output of the chopper op amp. The difference in the heating effect of these voltages is the dc input to the chopper op amp. This difference input is amplified and is fed to TC402 and also, after going through the output amplifier (U602), to the meter (M1). This voltage represents the rms value of the ac signal applied to the 3400A's INPUT jack. By using two "matched" thermocouples and measuring the difference, the output of the chopper op amp will be linear. Using two thermocouples also provides temperature stability.

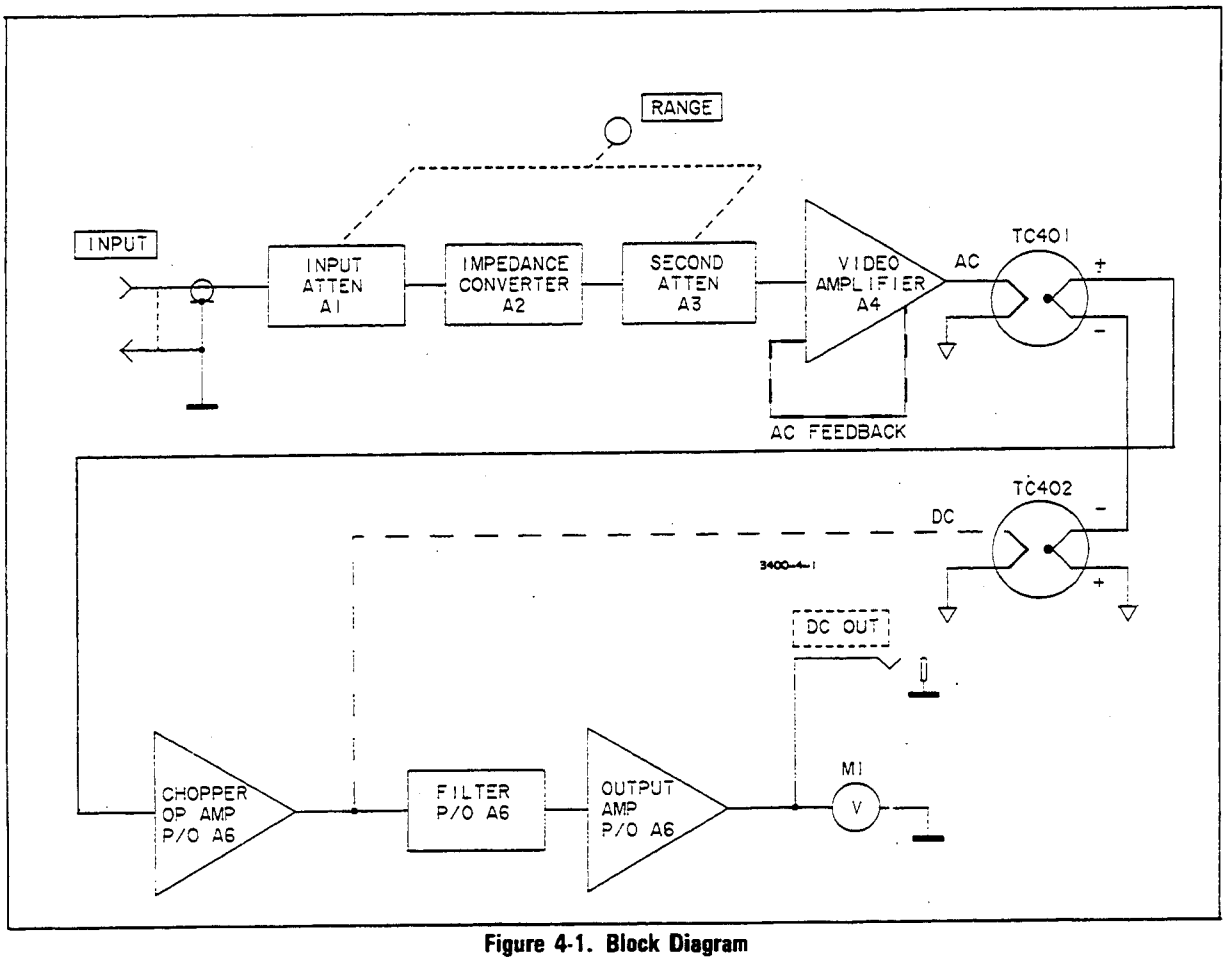


Figure 4-1. Block Diagram

4-10. The dc voltage driving meter M1 is also available at the DC OUT jack, located at the rear of the Model 3400A.

4-11. DETAILED DESCRIPTION

4-12. Input Attenuator Assembly A1

4-13. The input attenuator assembly is a capacitive-compensated attenuator which provides two ranges of attenuation for the 12 positions of the RANGE switch. See input attenuator schematic diagram illustrated on Figure 6-1.

4-14. When the RANGE switch is positioned to one of the six most sensitive ranges (.001 to .3 VOLTS), the attenuator output voltage is equal to the input voltage. When the RANGE switch is positioned to one of six highest ranges (1 to 300 VOLTS), the input signal is attenuated 60 dB (1000: 1 voltage division) by the resistive voltage divider consisting of R101, R103, and R104. Trimmer C102 is adjusted at 100 kHz, and R104 is adjusted at 400 Hz to provide constant attenuation over the input frequency range.

4-15. Impedance Converter Assembly A2

4-16. The impedance converter assembly uses a FET follower circuit to match the high output impedance of the input attenuator to the low input impedance of the second attenuator. The follower circuitry has unity gain with no phase inversion between the input and output signals. The circuitry is illustrated in Figure 6-1.

4-17. The ac input signal to the impedance converter is resistor/capacitor coupled via R202 and C201 to the gate of FET Q201. The output of the converter is developed across a Q202 which acts like a variable load resistor for the FET.

4-18. The bootstrap circuitry, consisting of C202 and R205, increases the input impedance of the converter circuitry and the compensating feedback circuitry, consisting of C204, decreases the output impedance of the converter. The C202 feedback circuitry is also used to flatten the converter's frequency response at high frequencies. The bias voltage for Q202 is developed by resistors R209, R210, R211, and CR206.

4-19. Second Attenuator Assembly A3

4-20. The second attenuator is a resistive divider which attenuates the ac input signal while maintaining a low impedance output for the following amplification stages. See second attenuator assembly schematic diagram illustrated in Figure 6-1.

4-21. The ac input signal is applied to a precision resistance voltage divider consisting of R302 through R312. These resistors are arranged to give six ranges of attenuation at 10 dB per range. The six ranges of the second attenuator combined with the two ranges of the input attenuator make up the 12 ranges of attenuation (0.001 to 300V). Trimmer capacitor C303 (10MHz 0.3V ADJ) provides an adjustment for frequency response at the higher frequencies.

4-22. Video Amplifier Assembly A4

4-23. The video amplifier functions to provide constant gain to the ac signal being measured over the entire frequency range of Model 3400A. See video amplifier assembly schematic diagram illustrated on Figure 6-2.

4-24. The ac input signal from the second attenuator is coupled through C402 to the base of input amplifier Q401. Q401, a class A amplifier, amplifies and inverts the signal which is then direct coupled to the base of bootstrap amplfier Q402. The output, taken from Q402 emitter is applied to the base of Q403 and fed back to the top of R406 as a bootstrap feedback. This positive ac feedback increases the effective ac resistance of R406 allowing a greater portion of the signal to be felt at the base of Q402. In this manner, the effective ac gain of Q401 is increased for the midband frequencies without disturbing the static operating voltages of Q401.

4-25. Driver amplifier Q403 further amplifies the ac signal and the output at Q403 collector is fed to the base circuit emitter follower Q404. The feedback path from the collector of Q403 to the base of Q402 through C405 (10 MHz ADJ) prevents spurious oscillations at high input frequencies. A dc feedback loop exists from the emitter circuit of Q403, to the base of Q401 through R425. This feedback stabilizes the Q401 bias voltage. Emitter follower Q404 acts as a driver for the output amplifier consisting of Q405 and Q406; a complimentary pair operating as a push-pull amplifier. The video amplifier output is taken from the collectors of the output amplifiers and applied to thermocouples TC401. A gain stabilizing feedback is developed in the emitter circuits of the output amplifiers. This negative feedback is applied to the emitter of input amplifier Q401 and establishes the overall gain of the video amplifier.

4-26. Trimmer capacitor C405 is adjusted at 10 MHz for frequency response of the video amplifier. Diodes CR402 and CR406 are protection diodes which prevent voltage surges from damaging transistors in the video amplifier. CR401, CR407, and CR408 are temperature compensating diodes to maintain the zero signal balance condition in the output amplifier over the operating temperature range. CR403, a breakdown diode, establishes the operating potentials for the output amplifier.

4-27. Chopper Op Amp Assembly A6 And Thermocouple Pair (Part Of A4)

4-28. The chopper op amp and thermocouple pair form a servo loop which functions to position the direct reading meter M1 to the rms value of the ac input signal. The chopper op amp and thermocouple pair schematic diagram is illustrated in Figure 6-3.

4-29. The video amplifier output signal is applied to the heater of thermocouple TC401. This ac voltage causes a dc voltage to be generated in the resistive portion of TC401 which is proportional to the heating effect (rms value) of the ac input. The dc voltage is applied to the chopper op amp.

4-30. The chopper op amp assembly consists of a chopper op amp (U601), filter, oscillator, and output amp (U602). The chopper op amp is a high gain low drift op amp and is used to modulate the applied dc voltage, amplify the voltage, and then demodulate the voltage back to dc (the output voltage of the amplifier). The output of the amplifier is the ac stabilizing and summing feedback for thermocouple TC402, and is also applied to the filter. The ac stabilizing feedback (using R614, R615, and C605) is used to prevent the circuitry from oscillating.

4-31. The oscillator consisting of Q601, Q602, and associated circuitry, is used to reduce the noise of the chopper op amp. It operates at a frequency of approximately 2KHz.

4-32. The output from the chopper op amp (summing feedback) is applied to the heating element of thermocouple TC402. The dc voltage developed in the resistive portion of TC402 is effectively subtracted from the voltage developed by TC401. The input signal to the chopper op amp then becomes the difference in the dc outputs of the two thermocouples. When the difference between the two thermocouples becomes zero, the dc output from the chopper op amp will be equal to the ac from the video amplifier.

4-33. The filter, consisting of R617, R618, R619, C607 and C608, is used to further reduce the noise on the output of the chopper op amp. This is to make the meter reading quiet.

4-34. The output of the filter is connected to the output amp (U602). The purpose of the amplifier is to drive the meter (M1) and to provide a low impedance output for the rear D.C. OUT connector. The output impedance of the amplifier is approximately 1 ohm. Since there are two 499 ohm resistors (R624 and R631) between the amplifier output and the rear terminal, the output impedance at the terminal is approximately 1000 ohms.

4-35. Other circuits, consisting of C611, R629, and R630, are used to speed up the step response of the 3400A.

4-36. Power Supply Assembly A7

4-37. The power supply assembly provides dc operating voltages for the tube and transistors used in the Model 3400A. See power supply assembly schematic diagram illustrated on Figure 6-4.

4-38. Either 115 or 230 volts ac is connected to the primary of power transformer T1 through fuse F1 and the POWER switch S1. Switch S2 (slide switch on rear panel) connects T1 primary windings in series for 230-volt operation or in parallel for 115-volt operation. Neon lamp DS1 lights to indicate LINE power ON when ac power is applied and S1 is closed.

4-39. Regulator Operation

4-40. The series regulator acts as a dynamic variable resistor in series with the power supply output. A control amplifier senses changes in the output voltage by comparing the output with a fixed reference voltage. The control amplifier then supplies any output voltage changes to the driver transistor, which in turn changes the resistance of the series regulator to oppose the change in output voltage. Diodes CR704, CR713 and CR706 across the base emitter junction of the series regulator provide overload current protection.

4-41. +75 Volt Supply

4-42. The +75 volt supply consists of a full-wave rectifier (CR701 and CR702) whose output is filtered by C1A and C1B and regulated by series regulator Q1. The +75 volt supply provides regulated +75 volts which is used as the plate supply voltage for V201. Voltage variation from the output is felt at Q702 base circuit through C704, R715, and R716. The C703 and R709 network provides phase correction for power supply stability. The regulation circuitry is in the negative leg of the +75 volt supply, and uses the -17.5 volt supply as a reference.

4-43. −17.5 Volt Supply

4-44. The regulated −17.5 volt supply consists of a full-wave rectifier (CR711, and CR712) whose output is filtered by C706 and C707 and regulated by Q2. Breakdown diode CR715 provides reference voltage at the base of Q704. Regulation operation is the same described in Paragraph 4-40.

WARNING

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains the information necessary for maintenance of the Model 3400A RMS Voltmeter. Included are performance checks, adjustment and calibration procedures, and troubleshooting procedures.

5-3. TEST EQUIPMENT

5-4. The test equipment required for the maintenance of the Model 3400A is listed in Table 5-1. If the recommended model is not available, use any substitute that meets the required characteristics.

5-5. PERFORMANCE CHECKS

5-6. The Performance Checks are in-cabinet tests that compare the Model 3400A with its given specifications. These checks may be used for incoming inspection, periodic maintenance, and for specification checks after a repair. A Performance Check Test Card is provided at the end of this section for recording the performance of the instrument during the Performance Checks. The card may be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. If the instrument fails to meet any of its specifications, perform the Adjustment and Calibration Procedures outlined in Paragraph 5-15.

NOTE

Allow a 30-minute warmup period before making performance checks. During the performance checks, periodically vary the Model 3400A line voltage ± 10% with a power line transformer to assure that the instrument operates correctly at various ac line voltages.

5-7. Accuracy, Linearity, And DC Output Check

5-8. The accuracy, linearity, and dc output test set-up is illustrated in Figure 5-1. A Meter Calibrator Fluke Model 760A and a Digital Multimeter -hp- Model 3468A/B are required for this test.

a. Connect test setup illustrated in Figure 5-1.

b. Set Model 3400A RANGE switch to 0.001 position.

c. Adjust the Meter Calibrator for a 0.001V 400Hz ac volts output; set the Digital Multimeter to measure 1V dc.

d. If Model 3400A does not indicate within values listed under "meter reading" in Table 5-2, perform low frequency calibration procedure, Paragraph 5-21. Record 3400A readings.

e. DC output as indicated on the Digital Multimeter should be within values listed under "3400A DC output" in Table 5-2.

f. Continue to check accuracy, linearity, and dc output using Table 5-2.

Table 5-1. Required Test Equipment

Instrument Type	Required Characteristics	Use	Recommended Model
DC Digital Multimeter	Accuracy: ±0.1% full scale Voltage Range: 10mV to 100V	Performance Checks Adjustment and Calibration	-hp- Model 3468A/B
Meter Calibrator	Voltage Range: 1mV to 300 V rms Frequency: 400 Hz	Performance Checks Adjustment and Calibration Troubleshooting	Fluke Model 760A
Oscillator	Frequency Range: 10 Hz to 10 MHz Output: 1 mV to 3 V Frequency Response: 0.25%	Performance Checks Adjustment and Calibration Troubleshooting	-hp- Model 654A Test Oscillator
Oscilloscope	Sensitivity: .005V/cm Bandwidth: dc to 20 MHz	Troubleshooting	-hp- Model 1740A
Pulse Generator	Pulse Width: variable to 10μsec Pulse Amp: ±10 volts peak, variable Pulse Rate: 250 to 1000 pps	Performance Checks	-hp- Model 214B
Frequency Counter	Range: 250 to 1000 Hz Accuracy: ±1 count Time Interval: 1μsec	Performance Checks	-hp- Model 5381A
Peak Responding Voltmeter	Voltage Range: 0.5 V to 300 V Accuracy: ±3% full scale	Performance Checks	-hp- Model 410C Voltmeter
Average Responding Voltmeter	Voltage Range: 0.001 to 300 V Accuracy: 1% full scale	Adjustment and Calibration Troubleshooting	-hp- Model 400E/EL Voltmeter
Power Supply	Output Voltage: 5 V dc Output Current: 5 mA	Troubleshooting	-hp- Model 6214B
RMS Responding Voltmeter	Range: 1 m V full scale	Performance Checks	-hp- Model 3400A RMS Voltmeter
Resistor	200 kΩ, metal film, ¼ W 1%	Performance Checks	-hp- Part No. 0757-0782
Resistor	499 kΩ, metal film, ¼ W 1%	Troubleshooting	-hp- Part No. 0757-0327
Resistor	1k Ω, metal film 1/8 W 0.1%	Troubleshooting	-hp- Part No. 0698-7449
50 Ω Feedthru Termination	Resistor: fixed comp 50Ω ±5% ¼ W	Performance Checks	-hp- Model 11048B 50Ω Feedthru
BNC-T-Adapter	— —	Performance Checks Adjustment and Calibration	-hp- Part No. 1250-0072
Adapter	410C to Dual Banana	Performance Checks	-hp- Model 11018A
Extender Board	15 pin	Troubleshooting	-hp- Part No. 5060-6038

Table 5-2. Accuracy, Linearity, and DC Output Check Data

Voltmeter Calibrator Output (V)	3400A Voltage Range (V)	3400A Meter Reading (V)	3400A DC Output (V)
0.001	0.001	0.000990 to 0.00101	0.992 to 1.008
0.003	0.003	0.00297 to 0.00303	0.942 to 0.957
0.01	0.01	0.00990 to 0.0101	0.992 to 1.008
0.03	0.03	0.0297 to 0.0303	0.942 to 0.957
0.1	0.1	0.0990 to 0.101	0.992 to 1.008
0.3	0.3	0.297 to 0.303	0.942 to 0.957
1.0	1.0	0.990 to 1.01	0.992 to 1.008
0.9	1.0	0.89 to 0.91	0.892 to 0.908
0.8	1.0	0.79 to 0.81	0.792 to 0.808
0.7	1.0	0.69 to 0.71	0.692 to 0.708
0.6	1.0	0.59 to 0.61	0.592 to 0.608
0.5	1.0	0.49 to 0.51	0.492 to 0.508
0.4	1.0	0.39 to 0.41	0.392 to 0.408
0.3	1.0	0.29 to 0.31	0.292 to 0.308
0.2	1.0	0.19 to 0.21	0.192 to 0.208
0.1	1.0	0.090 to 0.11	0.092 to 0.108
3.0	3.0	2.97 to 3.03	0.942 to 0.957
10.0	10.0	9.90 to 10.10	0.992 to 1.008
30.0	30.0	29.7 to 30.3	0.942 to 0.957
100.0	100.0	99.0 to 101.0	0.992 to 1.008
300.0	300.0	297.0 to 303.0	0.942 to 0.957

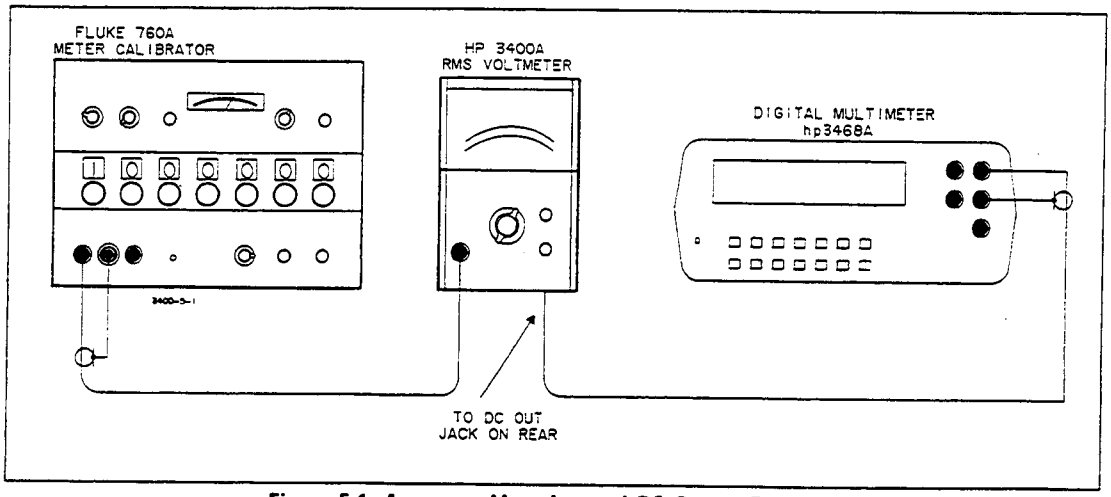


Figure 5-1. Accuracy, Linearity, and DC Output Test Setup

5-9. Frequency Response Check

NOTE

Connect the 50 ohm feedthru termination directly to the 3400A INPUT, to eliminate high frequency losses in the output cable.

a. Connect the test setup shown in Figure 5-2.

b. Set the -hp- Model 3400A RANGE switch and Test Oscillator output attenuator to the 1 volt position.

c. Set the Test Oscillator for a 400 Hz output. Adjust its amplitude for the reading obtained in paragraph 5-8 step d, on the 3400A.

d. Adjust the Test Oscillator frequency to the values listed under "Frequency" in Table 5-3. Make sure the 3400A is within the limits shown under "Meter Reading" in the table. If out of the indicated limits, perform the High Frequency Calibration procedure in paragraph 5-26.

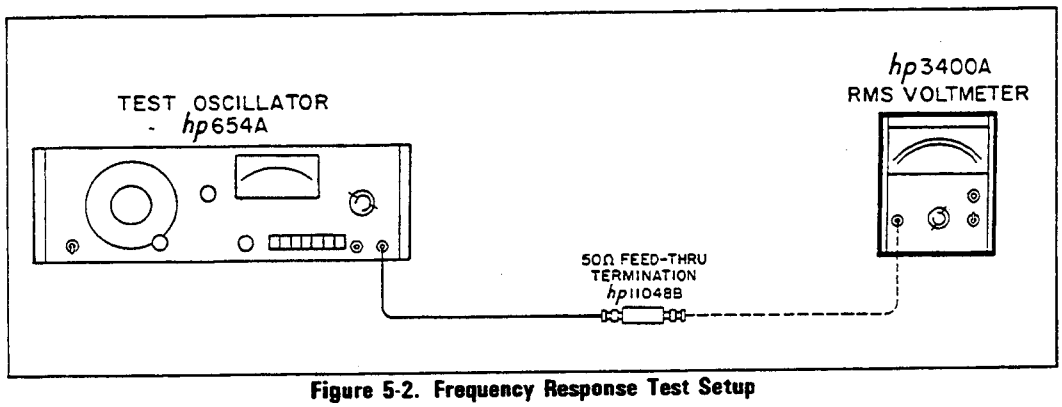


Figure 5-2. Frequency Response Test Setup

Table 5-3. Frequency Response Check

Frequency	Meter Reading
15 Hz	0.95 to 1.05
45 Hz	0.95 to 1.05
100 Hz	0.99 to 1.01
900 kHz	0.99 to 1.01
1.2 MHz	0.98 to 1.02
1.8 MHz	0.98 to 1.02
2.2 MHz	0.97 to 1.03
2.8 MHz	0.97 to 1.03
3.2 MHz	0.95 to 1.05
9.8 MHz	0.95 to 1.05

5-10. Input Impedance Check

5-11. Resistance Check. Do the following:

a. Connect the Test Oscillator, 50 ohm feedthru and -hp- Model 3400A to position A in Figure 5-3.

b. Set 3400A to 1 volt range and Test Oscillator to 400 Hz.

c. Adjust Test Oscillator output for 1 volt indication on Model 3400A.

d. Connect Model 3400A to position B, as shown in Figure 5-3. The 3400A meter reading now should change less than or equal to .02 volts (2 minor divisions). 2 minor divisions corresponds to an input impedance of 10 megohms.

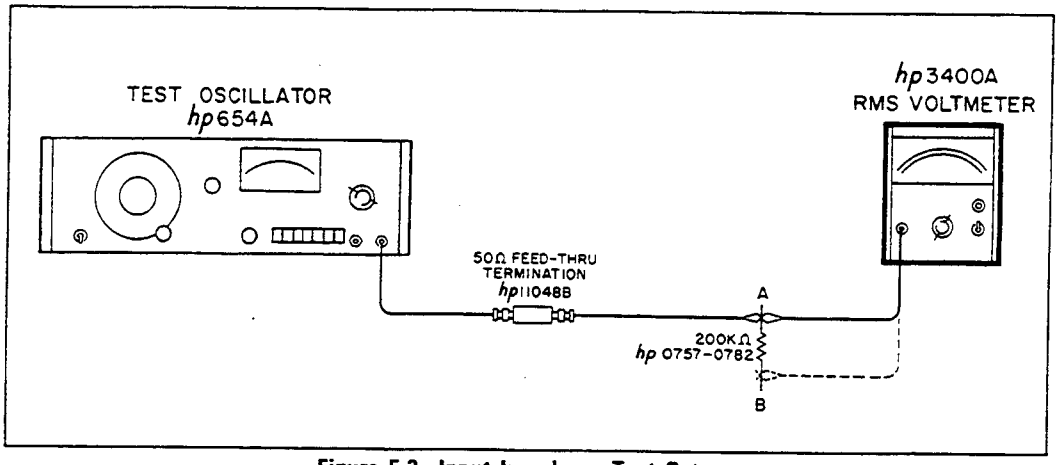


Figure 5-3. Input Impedance Test Setup

5-12. Capacitance Check. Do the following:

a. Connect the Test Oscillator, 50 ohm feedthru termination, and the -hp- Model 3400A as shown in Figure 5-3. Make sure the 3400A is connected to position B, and NOT position A. Insert the resistor directly into the 3400A's input BNC and connect the other end to the feedthru termination. This minimizes the effect of any external capacitance.

b. Set the 3400A to the .001 V range and the Test Oscillator for a 400 Hz output.

c. Adjust the Test Oscillator for a full scale reading on the 3400A.

d. Change the Test Oscillator frequency to 16 kHz and make sure the 3400A reading is greater than .707 mV. This corresponds to an input shunt capacitance of less than 50 pF.

e. Set the 3400A to the 1 V range and the Test Oscillator for a 400 Hz output. Repeat step c.

f. Change the Test Oscillator frequency to 40 kHz and make sure the 3400A reading is greater than .707 V. This corresponds to an input shunt capacitance of less than 20 pF.

5-13. Crest Factor Check

a. Connect test setup as illustrated in Figure 5-4.

b. Set Model 3400A Range switch to 1 volt position.

c. Adjust Pulse Generator for pulse output with the following characteristics:

Pulse Rate - 990 pps as indicated on electronic counter.

Pulse Width - 10 μsec as indicated on electronic counter in time internal mode.

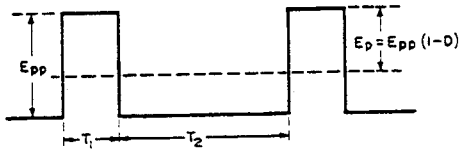
Pulse Amplitude - 7.07 volts as indicated on Model 410C.

NOTE

The 410C responds to the positive peak above the average of the input waveform. Since the Model 410C is calibrated to read the rms value of a sine wave a correction factor is required to measure pulse amplitude. The correction factor under these conditions is:

$$E_{410C} = \frac{E_{pp}}{\sqrt{2}\left(1 + \frac{T_1}{T_2}\right)}$$

see waveform



$$E_p = \frac{T_2}{T_1 + T_2}$$

$$E_{410C} = \frac{}{\sqrt{2}\left(1 + \frac{T_1}{T_2}\right)}$$

$$E_{410C} = 7.07V$$

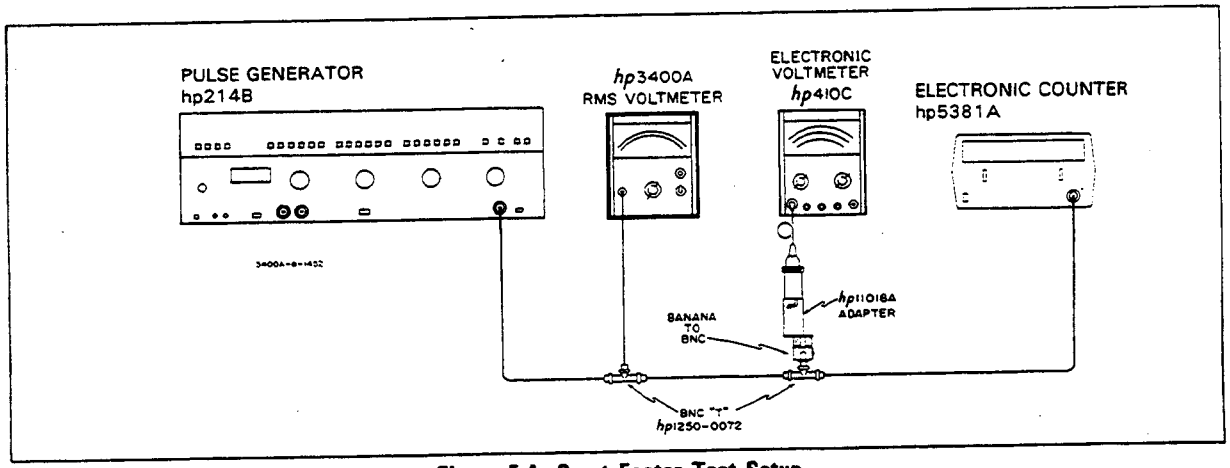


Figure 5-4. Crest Factor Test Setup

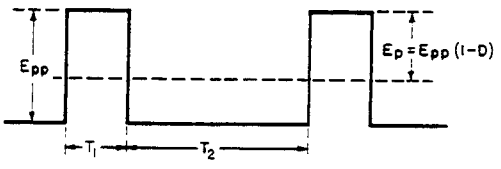
This corresponds to a crest factor of 10 where:

$$E_{rms} = E_{pp}\sqrt{D(1-D)} \text{ where } D = \frac{T_1}{T_1 + T_2}$$

$$C.F. = \frac{E_p}{E_{rms}}$$

$$C.F. = \frac{E_{pp}(1-D)}{E_{pp}\sqrt{D(1-D)}}$$

$$C.F. = \sqrt{\frac{1-D}{D}}$$



d. The Model 3400A should indicate 1 volt, ±4% (includes the ±3% accuracy of 410C).

e. Adjust pulse generator pulse rate to 250 pps as indicated on electronic counter. This corresponds to a crest factor of 20.

f. Model 3400A should indicate 0.5 volt, ±4% (includes the ±3% accuracy of 410C.)

5-14. Output Noise Check

a. Connect 50 ohm feedthru to 3400A INPUT.

b. Connect another RMS Voltmeter to DC output.

c. Set -hp- Model 3400A to 0.001 volt range.

d. The reading on the RMS Voltmeter should not exceed 1 mV.

5-15. ADJUSTMENT AND CALIBRATION PROCEDURES

5-16. The following is a complete adjustment and calibration procedure for the Model 3400A. These procedures should be conducted only if it has previously been established by Performance Checks, Paragraph 5-5 to 5-14, that the Model 3400A is out of adjustment. Indiscriminate adjustment of the internal controls to refine settings may actually cause more difficulty. If the procedures outlined do not rectify any maladjustments that may exist, and you have carefully rechecked your connections and settings, refer to Paragraph 5-29, Troubleshooting Procedures for possible cause and recommended corrective action.

NOTE

Unless otherwise noted, the 3400A's top and side covers have to be removed to calibrate and adjust the instrument.

5-17. Mechanical Meter Zero

5-18. The mechanical meter zero screw is located on the instrument front panel. If the meter pointer does not indicate zero when the instrument power has been off for at least one minute, mechanically zero the meter following the procedure outlined below.

a. Turn instrument power off; disconnect input signal and any cable connected to J2 (DC OUT) at rear of instrument and allow one minute for meter pointer to stabilize.

b. Rotate zero adjust CW until pointer is to left of zero, moving up scale. Continue until pointer is at zero. If pointer overshoots zero, repeat operation.

c. When the pointer is exactly at zero, rotate the adjusting screw slightly counterclockwise to remove tension on pointer suspension. If the meter pointer moves to the left during this adjustment, repeat steps b and c.

5-19. Power Supply Checks

5-20. Power supply voltage and ac ripple tolerances are listed in Table 5-4. Test points are also indicated in this table. When making ripple voltage measurements, it may be desirable to use a battery powered A.C. Voltmeter (H-P 403B) to avoid any undesirable ground loop currents.

5-21. Low Frequency Calibration

5-22. Amplifier Offset Adjustment. Do the following

a. Perform the following adjustment only for Revision C A6 assemblies. The adjustment is not required for Revision A assemblies.

b. Remove the 3400A's top cover.

c. Refer to the Chopper Amplifier component locator (see Page 6-7/6-8) and connect TP5 to TP1 (on the A6 assembly).

d. Connect a DC Voltmeter between TP6 and TP1.

e. Adjust A6R629 (on the A6 assembly) for a >2mV dc reading on the dc voltmeter.

5-23. Amplifier Gain Adjustment. Do the following

a. Connect test setup illustrated in Figure 5-1.

b. Set Model 3400A RANGE switch to 0.01 volt position.

c. Adjust the Meter Calibrator for a 0.01V 400Hz ac volts output; set the Digital Multimeter to measure 1V dc.

d. Remove the 3400A's top cover; adjust A6R627 (on the A6 assembly) for 1.0V as indicated on the Digital Multimeter.

e. Adjust R6 (FULL-SCALE ADJUST) for Model 3400A full-scale meter indication.

5-24. 1/10 Scale Adjustment. Do the following

a. Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.

b. Set Model 3400A RANGE switch to 0.1 volt position and adjust Voltmeter Calibrator for 0.01 volt rms, 400 Hz output.

NOTE

The meter may show a small positive offset when the 3400A's input is shorted. This is normal and the 3400A will be fully accurate from 1/10 scale to full scale.

c. Adjust the 1/10 scale adjust (A6R626, located on the A6 assembly) until the meter of the 3400A reads exactly 1/10 scale (.01V).

Table 5-4. Power Supply Checks

Power Supply	Test Equipment And Check Point	DC Voltage Specifications	Regulation (Vary Line Voltage Between 103.5 and 126.5 vac)	Ripple Specifications
−17.5 Vdc	Connect Digital Multimeter, Oscilloscope between violet lead on video amplifier (A4) board and chassis ground.	−16.8 to 18.2 Vdc	±0.5 volt from nominal reading at 115 Vac line.	400μV rms or 1.1 mV p-p
+75 Vdc	Connect Digital Multimeter, Oscilloscope between red/wht/blue on video amplifier A4 and chassis ground.	70.0 to 78.0 Vdc	±1 volt from nominal reading at 115 Vac line.	400μV rms or 1.1 mV p-p

5-25. 1 Volt Adjustment. Do the following:

a. Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.

b. Set Model 3400A RANGE switch to 1 volt position.

c. Adjust voltmeter calibrator for 1.0 volt rms, 400 Hz output.

d. Remove right side cover (INPUT side) and adjust R104 (1 V ADJUST) for Model 3400A full-scale meter indication.

NOTE

The adjustments in paragraph 5 – 24 and 5 – 25 may interact with each other and may have to be readjusted, after performing both adjustments.

5-26. High Frequency Calibration

5-27. Amplifier Gain Adjustment. Do the following:

NOTE

The Test Oscillator should be calibrated at the end of its output cable with 50 ohms termination connected at the end of the cable.

a. Connect the test setup shown in Figure 5-2.

b. Set the -hp- Model 3400A RANGE switch and Test Oscillator output attenuator to the .001 volt position.

c. Set the Test Oscillator for a 400 Hz output and adjust its amplitude for a 90% full scale reading on the 3400A.

d. Change the Test Oscillator frequency to 10 MHz.

e. Adjust C405 (10 MHz ADJUST) on the A4 Assembly for a 90% full scale reading on the 3400A. Replace the right side cover. If the reading changes after cover replacement, readjust C405

f. Vary the oscillator frequency between 3 and 10 MHz. If the 3400A reading goes above 95% or below 85% of full scale, repeat step e until optimum response is obtained between 3 and 10 MHz.

5-28. Input Attenuator Adjustment. Do the following:

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

a. Connect the test setup shown in Figure 5-2.

b. Set the -hp- Model 3400A RANGE switch and test Oscillator output attenuator to the 1 volt position.

c. Set the Test Oscillator for a 400 Hz output and adjust its amplitude for a 90% full scale reading on the 3400A.

d. Change the Test Oscillator frequency to 100 kHz.

e. Remove the bottom cover. Adjust C102 (1 V, 100 kHz ADJUST) for a 90% full scale reading on the 3400A.

f. Vary the oscillator frequency between 100 kHz and 10 MHz. If the 3400A reading varies more than ±1% from 100 kHz to 1 MHz, ±2% from, 1 MHz to 2 MHz, ±3% from 2 MHz to 3MHz, or ±5% from 3 MHz to 10 MHz, readjust C102 until optimum response is obtained.

5-29. Second Attenuator Adjustment. Do the following:

a. Connect the test setup shown in Figure 5-2.

b. Set the -hp- Model 3400A RANGE switch and Test Oscillator output attenuator to the .3 volt position.

c. Set the Test Oscillator for a 400 Hz output and adjust its amplitude for a 90% full scale reading on the 3400A.

d. Change the Test Oscillator frequency to 3 MHz.

e. Adjust C303 (10 MHz, .3 V ADJUST) for a 90% full scale reading on the 3400A.

f. Vary the oscillator frequency between 3 and 10 MHz. If the 3400A reading goes above 95% or below 85% of full scale, repeat step e until optimum response is obtained between.

5-30. TROUBLESHOOTING PROCEDURES

5-31. This section contains procedures designed to assist in the isolation of malfunctions. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the Adjustment and Calibration Procedures, Paragraph 5-15. An investigation should also be made to ensure that the trouble is not a result of conditions external to the Model 3400A.

5-32. Conduct a visual check of the Model 3400A for possible burned or loose components, loose connections, or any other condition which might suggest a source of trouble.

5-33. Table 5-5 contains a summary of known problems by front panel symptoms.

5-34. Table 5-6 contains procedures which may be used as a guide in isolating malfunctions. The checks outlined in Table 5-6 are not designed to measure all circuit parameters, rather only to localize the malfunction. Therefore, it is quite possible that additional measurements will be required to completely isolate the problem. Amplifier gain and biasing may vary slightly from instrument to instrument; therefore, it should not be necessary to precisely duplicate waveforms or values described.

NOTE

Do not use an extender board on the Chopper Amplifier Board (A6).

5-35. Checking Thermocouples TC401 and TC402

5-36. The following procedure shows how to check the thermocouples in the -hp- Model 3400A RMS Voltmeter for proper operation.

NOTE

This check will not yield any information concerning thermocouple operation for either sluggish or overshoot/undershoot response on the 3400A meter. If these symptoms are noted, replace the thermocouple.

Table 5-5. Front Panel Symptoms

Symptoms	Possible Causes
Reading far out of tolerance, meter pegged out.	Check for a defective oscillator on the A6 assembly.
Excessive offset (>8%) with input shorted.	A6R626 and/or C405 misadjusted.
400Hz calibration low and frequency response falls off above 50KHz.	Q401 or Q402 shorted.
Switching transients exceeds 5% of full scale with shorted input.	Check collector voltage of Q201 (should not exceed 9.0V)
Instrument has been overloaded.	Check Q201, Q401, Q402, and TC401. See paragraph 5-34 for details on TC401.
Meter jitty.	Noisy chopper op amp (U601).
Full-scale difference from range to range.	Check resistors in second attenuator.
Meter pegs full scale.	Check thermocouples. See paragraph 5-35 for details.
Overshoot, undershoot, or sluggish response on meter.	Replace thermocouples. See paragraph 5-38.
Meter moves rapidly from zero to full-scale and back.	Check ac feedback on the A6 assembly (R614, C605, and R615).

5-37. The thermocouple tests consist of checking the heater resistance and output voltage of each thermocouple. The heater resistance is checked using an ohmmeter. The output voltage is checked by supplying 5 mA dc current to the heater and then measuring the output voltage. If the thermocouple fails any of the tests, replace it using the procedure in paragraph 5-38. A Digital Multimeter (like the -hp- Model 3468A/B), a 10 V dc power supply (like the -hp- Model 6214B), and a 1 Kohm ±0.1% resistor (-hp- Part Number 0698-7449) are needed for the tests. Refer to Figure 5-5 while performing the following procedure.

a. Turn the 3400A off and remove the A6 assembly.

b. Set the digital multimeter to the ohms function. Connect the test leads between chassis ground and the junction of C413 and C415 on the A4 assembly. This checks the heater resistance of TC401. The multimeter reading should be between 76.5 ohms and 103.5 ohms. If the readings are out of the specified limits, replace the matched pair of thermocouples (-hp- Part Number 0863-0003).

NOTE

The following check applies to -hp- 3400A's with serial number prefix 2225 and above. For instruments that have a lower prefix, change step c to the following:

c. Connect the multimeter between the clear lead on R4 (CAL potentiometer on chassis) and pin 14 on the A6 socket. This checks the heater of TC402. Make sure the reading is between 76.5 ohms and 103.5 ohms. Replace the thermocouples if out of limits.

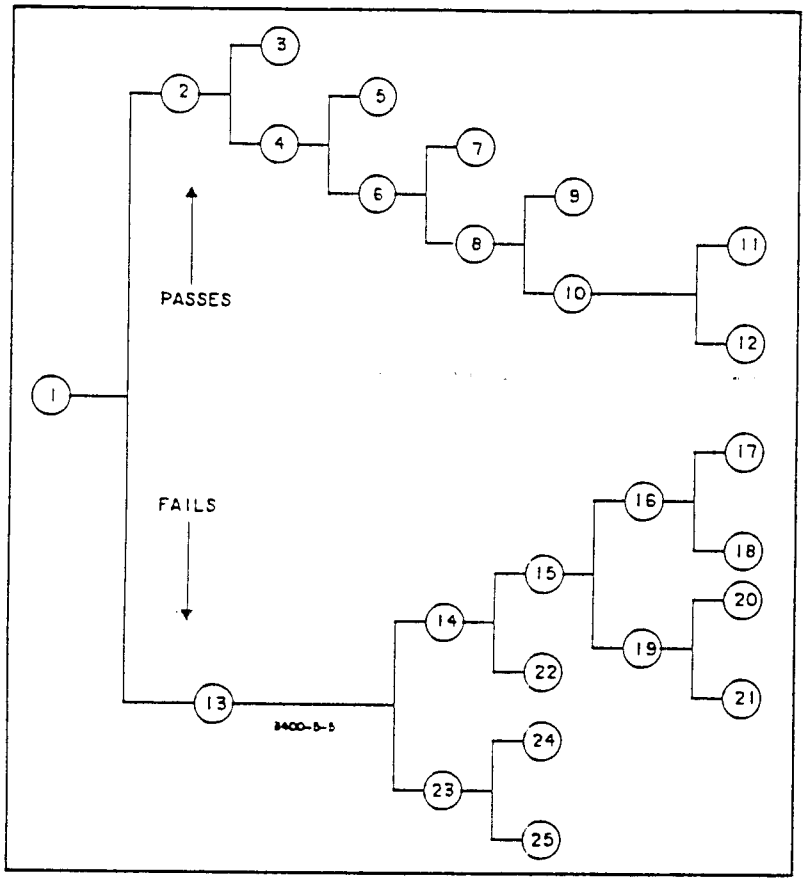


Figure 5-6. Troubleshooting Tree

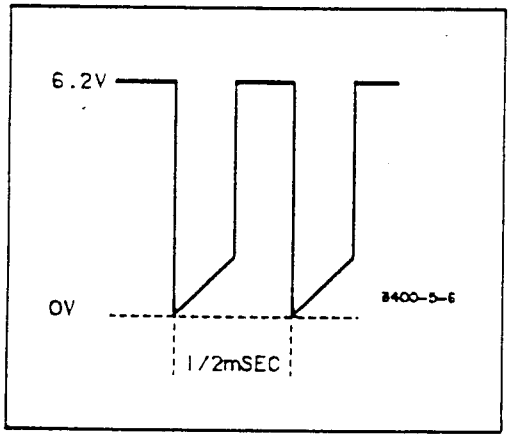


Figure 5-7. Input to Demodulator

Check	Procedure
1	Set the 3400A to the 1V range. Apply 1V 400Hz ac signal to the input terminals. Measure the signal at junction of C413 and 415. The reading should be between 240mV and 280mV RMS.
2	Measure the signal between TP2 and TP1 on the A6 assembly. The signal should look like the one in Figure 5-7.
3	Troubleshoot and repair oscillator circuitry.
4	Turn the 3400A off and place the A6 board on an extender board (-hp- 5060-6038). Unsolder and lift one end of R616 from the board (the dc feedback is now disconnected). Set the instrument to the 1V range and apply a 1V, 400Hz RMS ac signal to the input terminals. Using a Digital Multimeter (like the 3468A/B), measure the voltage between TP3 and TP1 on the A6 assembly. The voltage should be approximately 2mV to 2.5mV ac.
5	Check for a defective TC401. TC401 may also be disconnected from the output of the video amplifier via capacitors C413 and C415.
6	Turn the instrument off and replace and resolder R616 on the A6 board. Make sure the 3400A is still on the 1V range and the 1V, 400Hz signal is still applied. Turn the instrument on and measure the voltage between TP4 and TP1 on the A6 board. The voltage should approximately be -4V dc.
7	If the voltage is positive, check for a shorted CR603. If the voltage is negative but other than -4V, U602 or TC401 may be defective.
8	Check the voltage between TP5 and TP1 and make sure it is -.19V.
9	Troubleshoot the filter circuitry consisting of R617 through R619, and C606 through C608.
10	Check the voltage between TP6 and TP1 and make sure it is approximately -1V.

Table 5-6. Troubleshooting Procedure

Action	Check	Procedure	Action
PASSES: Proceed to (2) FAILS: Proceed to (13)	(11)	Check for a defective U602.	
	(12)	The A6 assembly is probably working correctly. Make sure the meter assembly M1 and associated circuitry are good.	
PASSES: Proceed to (4) FAILS: Proceed to (3)	(13)	Measure the ac signal at the output of impedance converter A2 (negative side of C205). The reading should be approximately .96mV RMS.	PASSES: Proceed to (14) FAILS: Proceed to (17)
PASSES: Proceed to (6) FAILS: Proceed to (5)	(14)	Measure the ac signal at the input of the video amplifier A4 (positive side of C402). The reading should be approximately .95mV RMS.	PASSES: Proceed to (15) FAILS Proceed to (22)
	(15)	Measure the ac signal at the base of Q404. The reading should be approximately 155mV RMS.	PASSES: Proceed to (16) FAILS: Proceed to (19)
	(16)	Measure the ac signal at the negative side C427. The reading should be approximately 32mV RMS.	PASSES: Proceed to (17) FAILS: Proceed to (18)
	(17)	Check for a defective C413 and C415.	
	(18)	Check for defective Q404, Q405, Q406 and associated circuitry. Also check the thermocouples (see paragraph 5-34).	
PASSES: Proceed to (8) FAILS: Proceed to (7)	(19)	Measure the ac signal at the emitter of Q402. Reading should be 1.85mV RMS	PASSES: Proceed to (20) FAILS: Proceed to (21)
	(20)	Check Q401 and Q402 circuitry.	
	(21)	Check Q403 circuitry.	
	(22)	Check second attenuator circuitry A3.	
PASSES: Proceed to (10) FAILS: Proceed to (9)	(23)	Measure the ac signal at the input to impedance converter, pin 7 on A2 board. The reading should be approximately 1mV RMS.	PASSES: Proceed to (24) FAILS: Proceed to (25)
	(24)	Check the impedance converter or power supply. See Table 5-4 for specifications on power supply.	
PASSES: Proceed to (12) FAILS: Proceed to (11)	(25)	Check the input attenuator circuitry.	

c. Connect the multimeter between pins 10 and 14 on the A6 socket. This checks the heater of TC402. Make sure the reading is between 76.5 ohms and 103.5 ohms. Replace the thermocouples if out of limits.

d. Connect the 1 Kohm resistor to the power supply as shown in Figure 5-5.

CAUTION

Make sure the power supply is adjusted to O V before turning it on. Also, do not apply more than 7 V to the thermocouples, or they may be damaged.

e. Connect the power supply and 1 Kohm resistor between the junction of C413 and C415, and ground. This checks the TC401 output voltage. Refer to Figure 5-5 and connect the HI lead of the multimeter to point A and the low lead to point B (i.e., across the resistor). Turn the power supply on and adjust it for a 5 V reading on the multimeter.

f. Remove the multimeter and then connect it as follows:

LO Input: to pin 11 on the A6 socket
HI input: to pin 13 on the A6 socket

g. Note the reading on the multimeter. It should display between +6.5 mV and +9 mV. If the reading is out of the specified limits, replace the thermocouples.

h. Set the power supply output to 0 V and disconnect it from the thermocouples.

NOTE

The following check applies to -hp- 3400A's with serial number prefix 2225 and above. For instruments that have a lower prefix, change step i to the following:

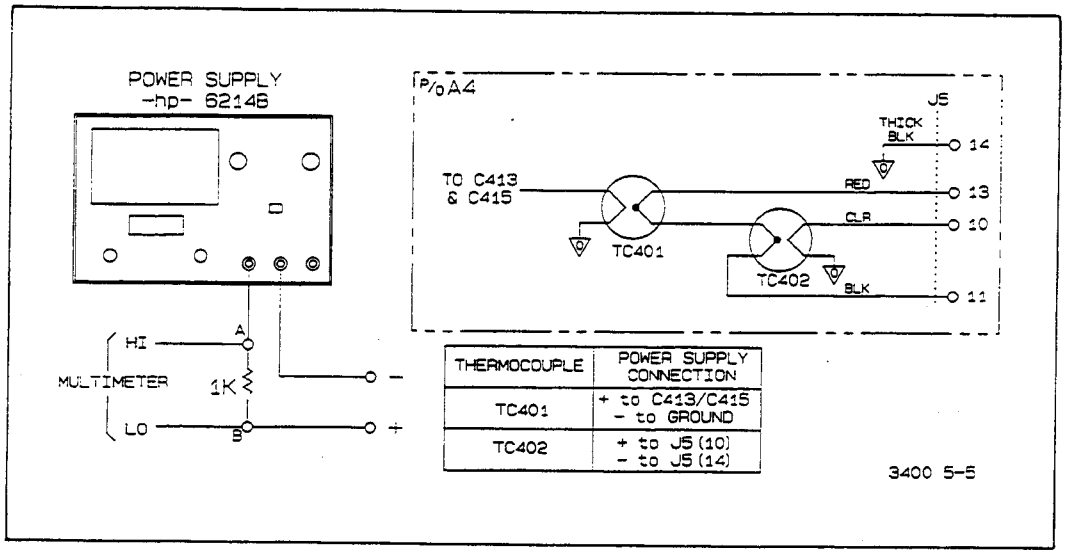


Figure 5-5. Testing the Thermocouples

i. Connect the power supply and 1 Kohm resistor between the clear lead on R4 and pin 14 on the A6 socket. This checks the TC402 output voltage. Refer to Figure 5-5 and connect the HI lead of the multimeter to point A and the low lead to point B (i.e., across the resistor). Turn the power supply on and adjust it for a 5 V reading on the multimeter.

i. Connect the power supply and 1 Kohm resistor between pins 10 and 14 on the A6 socket. This checks the TC402 output voltage. Refer to Figure 5-5 and connect the HI lead of the multimeter to point A and the low lead to point B (i.e., across the resistor). Turn the power supply on and adjust it for a 5 V reading on the multimeter.

j. Disconnect the multimeter and connect as in step f.

k. Make sure the multimeter reading is negative and within 1 mV of the reading noted in step g. It should display between +6.5 mV and +9 mV. If the reading is out of the specified limits, replace the thermocouples.

l. Disconnect the power supply, resistor, and multimeter from the 3400A. Set the multimeter to the ohms function and connect it between pins 11 and 14 on the A6 socket. This checks for thermocouple shorts to ground, through the cover. If the reading on the multimeter is below 200 Kohms, look for a short.

5-38. Thermocouple Replacement

CAUTION

Exercise extreme care when removing or replacing the amplifier printed circuit board assembly and when shaping the thermocouple leads.

5-39. Should a thermocouple be defective, it is necessary to replace both as a matched pair (see Section VII, Table of Replaceable Parts) for part number. To replace thermocouples, perform the following steps:

a. Turn instrument power off and remove right side (INPUT side) and top covers.

b. Remove the four lead connection to the A4 amplifier board.

1. Black coaxial cable (two leads)
2. Violet lead
3. White lead/blue lead.

c. Remove the three mounting screws on the amplifier board.

d. Gently pull bottom of board out at the same time relieving stress on thermocouple cable until the board will drop down and the top will clear main frame. Carefully fold board down to expose the four nuts holding the thermocouple shield.

e. Remove four shield nuts; lift shield off. Remove thermocouples, noting orientation.

f. Leads on new thermocouples must be shaped before inserting into PC board. During the shaping process, hold leads between bending point and glass with long-nose pliers.

g. Place the red dots on the thermocouples face down on the A4 Video Amplifier Board. If one of the thermocouples has an additional colored dot place it in the TC402 position.

h. Carefully insert new thermocouple leads and solder.

i. Reverse steps e, d, c, b. Note: the violet lead goes to the lower of the two top connectors on the A4 board.

j. After thermocouple replacements perform a complete adjustment and calibration procedure as outlined in Paragraph 5-15.

Table 5-7. Factory Selected Components

Designator	Function	Value Low	Value Normal	Value High
C205	Adjust low frequency (10 Hz) response.	—	100μF (selected)	—
C302	Adjust high frequency (10 MHz) of Second Attenuator on 0.001 V and 1 V ranges.	5 pF	12 pF	15 pF
C304	Adjust high frequency (3 MHz to 10 MHz) of Second Attenuator on 0.3 V and 300 V ranges.	—	24 pF	39 pF
C305	Adjust high frequency (10 MHz) of Second Attenuator on 0.01 V and 10 V ranges.	—	5 pF	12 pF
C427	See NOTE on schematic.	—	200 μF (selected)	—
R419	Adjust voltage at collector of Q406 (with no signal input) to 1.5V to 2.5V dc.	270	300	—

5-40. SERVICING ETCHED CIRCUIT BOARDS

5-41. The -hp- Model 3400A has five etched circuit boards. Use caution when removing them to avoid damaging mounted components. The assembly and -hp- Part No. are silk screened on the interior of the circuit board to identify it. Refer to Section VII for parts replacement and -hp- part number information.

5-42. The etched circuit boards are plated-through type. The electrical connection between sides of the board is made by a layer of metal plated through the component holes. When working on these boards, observe the following general rules:

a. Use a low-heat (25 to 50 watts) small-tip soldering iron and a small diameter rosin core solder.

b. Circuit components can be removed by replacing the soldering iron on the component lead on either side of the board and pulling upon lead. If a component is obviously damaged, clip leads as close to component as possible and then remove. Excess heat can cause the circuit and board to separate or cause damage to the component.

c. Component lead hole should be cleaned before inserting new lead.

d. To replace components, shape new leads and insert them in holes. Reheat with iron and add solder as required to insure a good electrical connection.

e. Clean excess flux from the connection and adjoining area.

5-43. A6 ASSEMBLY (03400-66512) RETROFIT PROCEDURE

5-44. The following procedure can be used to retrofit older 3400A's that have the old A6 Assembly (-hp- Part Number: 03400-66508) with the presently available A6 Assembly (-hp- Part Number: 03400-66512). Since modifications to the A7 Assembly (Power Supply) and to other associated components of the A6 Assembly are required, you should obtain a 3400A manual that has the schematics (Figures 6-3 and 6-4) for the old A6 and A7 Assemblies. (A manual with -hp- Part Number 03400-90008 or lower is a good choice.) Do the following:

a. Turn the 3400A off and disconnect it from the ac power source.

b. Refer to Figure 6-3 (schematic of the old A6 Assembly), and locate and remove R3, R8, R9, and R10 from the instrument. These parts and parts in the next step are located next to the A6 Assembly connector.

c. Refer to Figure 6-3 again and locate resistor R4. Connect and solder both legs of R4 together, or connect pin 10 of the A6 Assembly connector to the CLR line of thermocouple TC402.

d. Refer to Figure 6-4 (schematic of the old A7 Assembly) and locate C711, C712, CR718, CR719, R701, R702, R712, R713, and Q706 on the A7 Assembly. Then remove the components from the assembly.

e. Remove the old A6 Assembly (03400-66508) and replace it with the new A6 Assembly (03400-66512).

f. Connect the 3400A to the ac power source and turn it on. After the recommended warm-up, calibrate the instrument using the calibration procedure in paragraph 5-15.

NOTE

After calibrating the 3400A, the instrument may display a small offset with 0 V inputs. This is normal and the 3400A should be fully accurate from 1/10 scale to full scale.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3400A
RMS Voltmeter
Serial No._____

Tests performed by_____
Date_____

Description	Check

Accuracy, Linearity and DC Output:

Calibrator Output	3400A Range	Meter Reading		DC Output	
0.001	0.001	0.000990	0.00101	0.992	1.008
0.003	0.003	0.00297	0.00303	0.942	0.957
0.01	0.01	0.00990	0.0101	0.992	1.008
0.03	0.03	0.0297	0.0303	0.942	0.957
0.1	0.1	0.0990	0.101	0.992	1.008
0.3	0.3	0.297	0.303	0.942	0.957
1.0	1.0	0.990	1.01	0.992	1.008
0.9	1.0	0.90	0.91	0.892	0.908
0.8	1.0	0.79	0.81	0.792	0.808
0.7	1.0	0.69	0.71	0.692	0.708
0.6	1.0	0.59	0.61	0.592	0.608
0.5	1.0	0.49	0.51	0.492	0.508
0.4	1.0	0.39	0.41	0.392	0.408
0.3	1.0	0.29	0.31	0.292	0.308
0.2	1.0	0.19	0.21	0.192	0.208
0.1	1.0	0.090	0.11	0.092	0.108
3.0	3.0	2.97	3.03	0.942	0.957
10.0	10.0	9.90	10.10	0.992	1.008
30.0	30.0	29.7	30.3	0.942	0.957
100.0	100.0	99.0	101.0	0.992	1.008
300.0	300.0	297.0	303.0	0.942	0.957

Frequency Response Check:

Frequency	Meter Reading	
15 Hz	0.95	1.05
45 Hz	0.95	1.05
100 Hz	0.99	1.01
900 kHz	0.99	1.01
1.2 MHz	0.98	1.02
1.8 MHz	0.98	1.02
2.2 MHz	0.97	1.03
2.8 MHz	0.97	1.03
3.2 MHz	0.95	1.05
9.8 MHz	0.95	1.05

Input Impedance Check:

Resistance _____ 10 MΩ or greater
Capacitance _____ 50 pF or less 0.001 V to 0.3 V
_____ 20 pF or less 1 V to 300 V

Crest Factor Check:

_____ 10:1 full scale
_____ 20:1 half scale

Output Noise Check:

_____ 1 mV RMS or less

SECTION VI
CIRCUIT DIAGRAMS

6-1. INTRODUCTION

6-2. This section contains the circuit diagrams necessary for the operation and maintenance of the Model 3400A RMS Voltmeter. Included are schematic and parts location diagrams.

6-3. SCHEMATIC DIAGRAMS

6-4. The schematic diagrams depict the circuits contained within each assembly of the 3400A as well as assembly interconnection. Main signal paths and significant feedback paths are identified.

6-5. The schematic diagrams are arranged in ascending order of assembly reference designation.

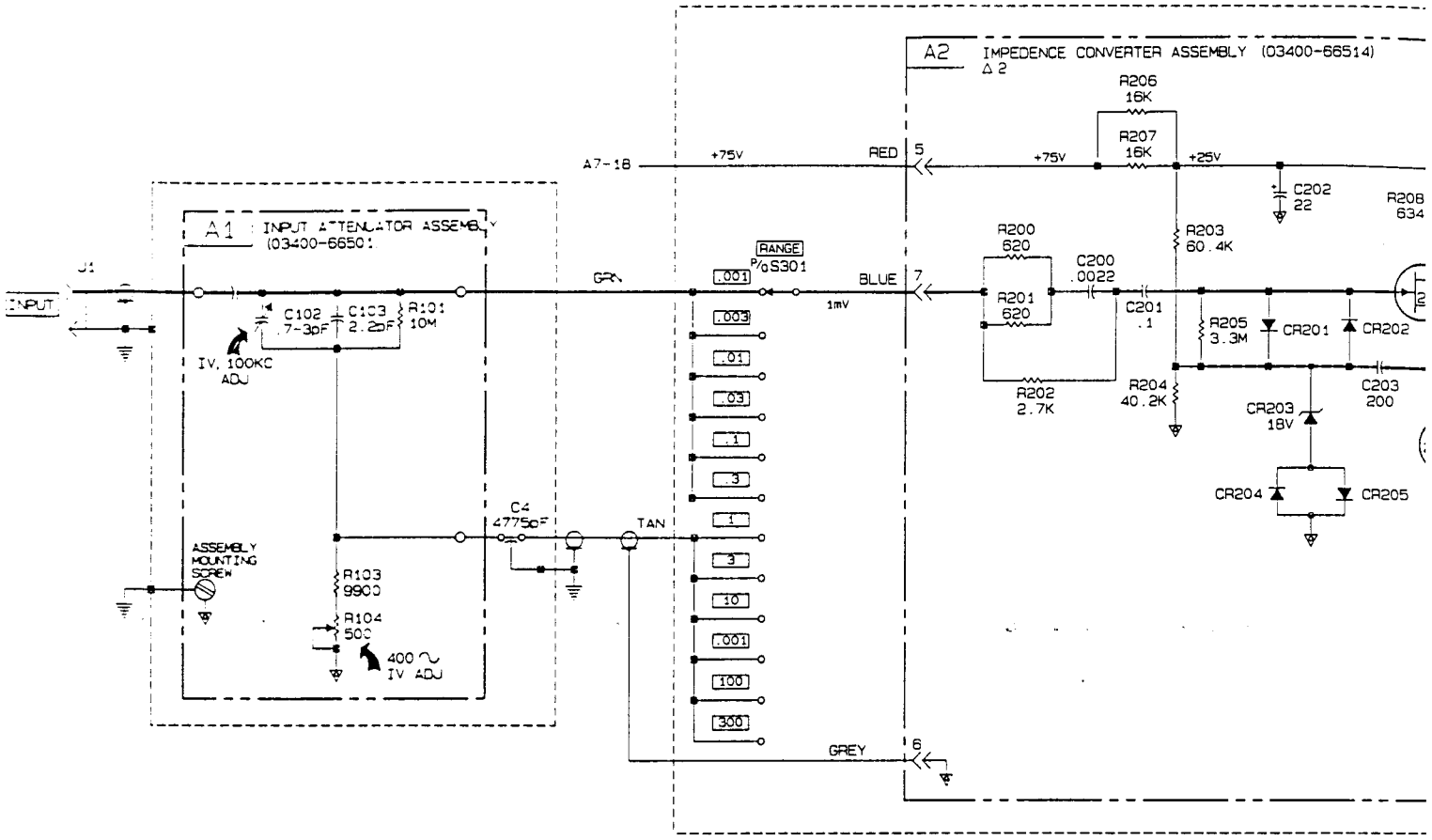
6-6. PARTS LOCATION DIAGRAMS

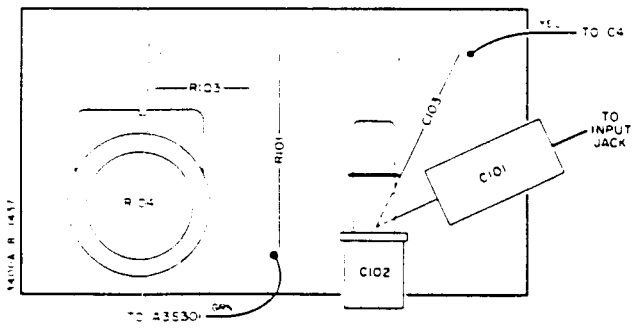
6-7. The parts location diagrams show the physical location of parts within an assembly. Parts are identified by reference designation. A parts location diagram is included for each assembly which does not have adequate silk screening of reference designations.

6-8. The parts location diagrams are located on the same figure as the schematic of the assembly.

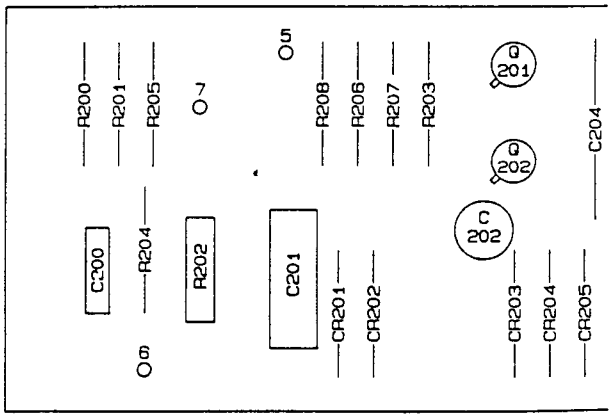
GENERAL SCHEMATIC NOTES

1. COMPLETE REFERENCE DESIGNATIONS ARE SHOWN.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ⏚ DENOTES POWER LINE GROUND (VOLTMETER CHASSIS ⊥).
   ▽ DENOTES CIRCUIT GROUND; ON PRINTED CIRCUIT ASSEMBLY.
4. ——— – – ——— DENOTES ASSEMBLY.
   ——— DENOTES MAIN SIGNAL PATH.
   ——— DENOTES DC FEEDBACK PATH.
   ——●——●——●——— DENOTES AC FEEDBACK PATH.
   — — — — — — — — DENOTES SHIELD.
5. ▭ DENOTES FRONT PANEL MARKING.
   ▭ DENOTES REAR PANEL MARKING.
   DENOTES SCREWDRIVER ADJUST.
6. DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
7. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY. SEE TABLE 5-7.
8. —<← DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.

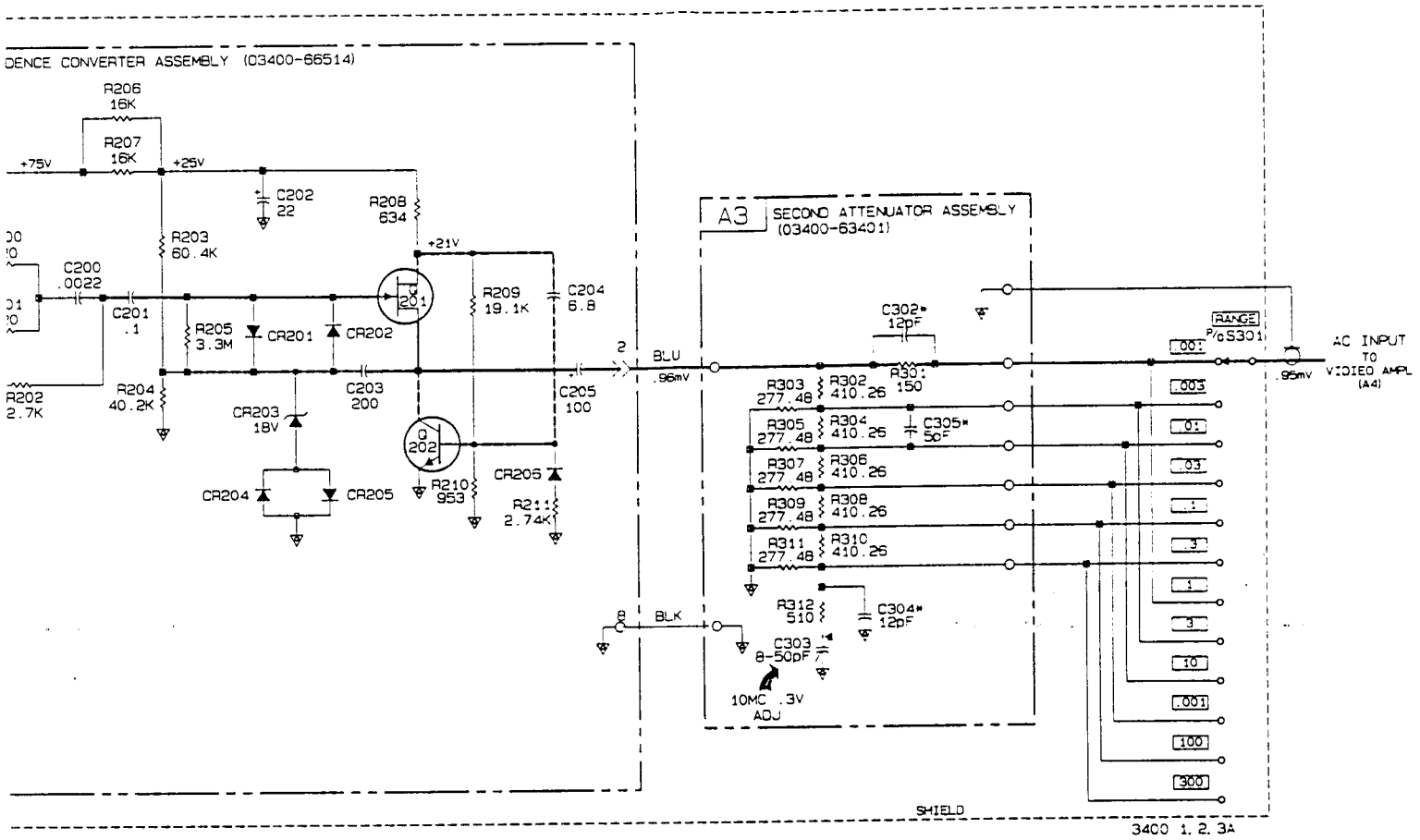


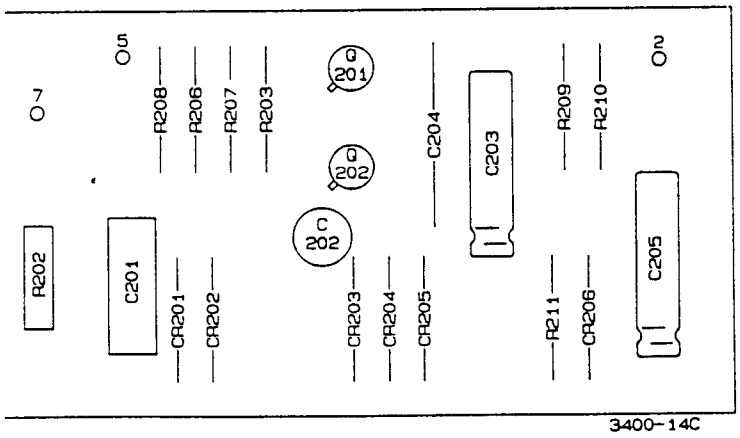


A1
(-hp- Part No. 03400-66501)



A2
(-hp- Part No. 03400-66514) Δ2





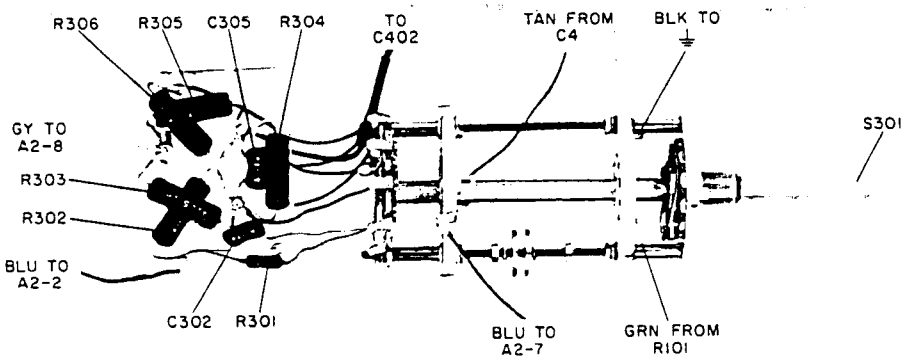
A2
(Hp- Part No. 03400-66514) A2

Figure 6-1. Input Attenuator A1, Impedance Converter A2, and Second Attenuator A3 Schematic and Parts Location Diagram

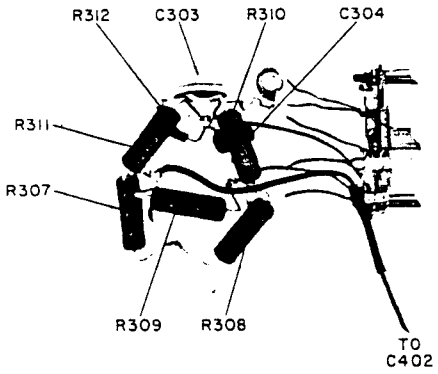
NOTES

1. ALL DC AND AC VOLTAGE LEVELS SHOWN IN RED ARE WITH 1 MV INPUT (FULL SCALE DEFLECTION). A TOLERANCE OF ±10% SHOULD BE ALLOWED FOR VARIATIONS FROM INSTRUMENT TO INSTRUMENT.

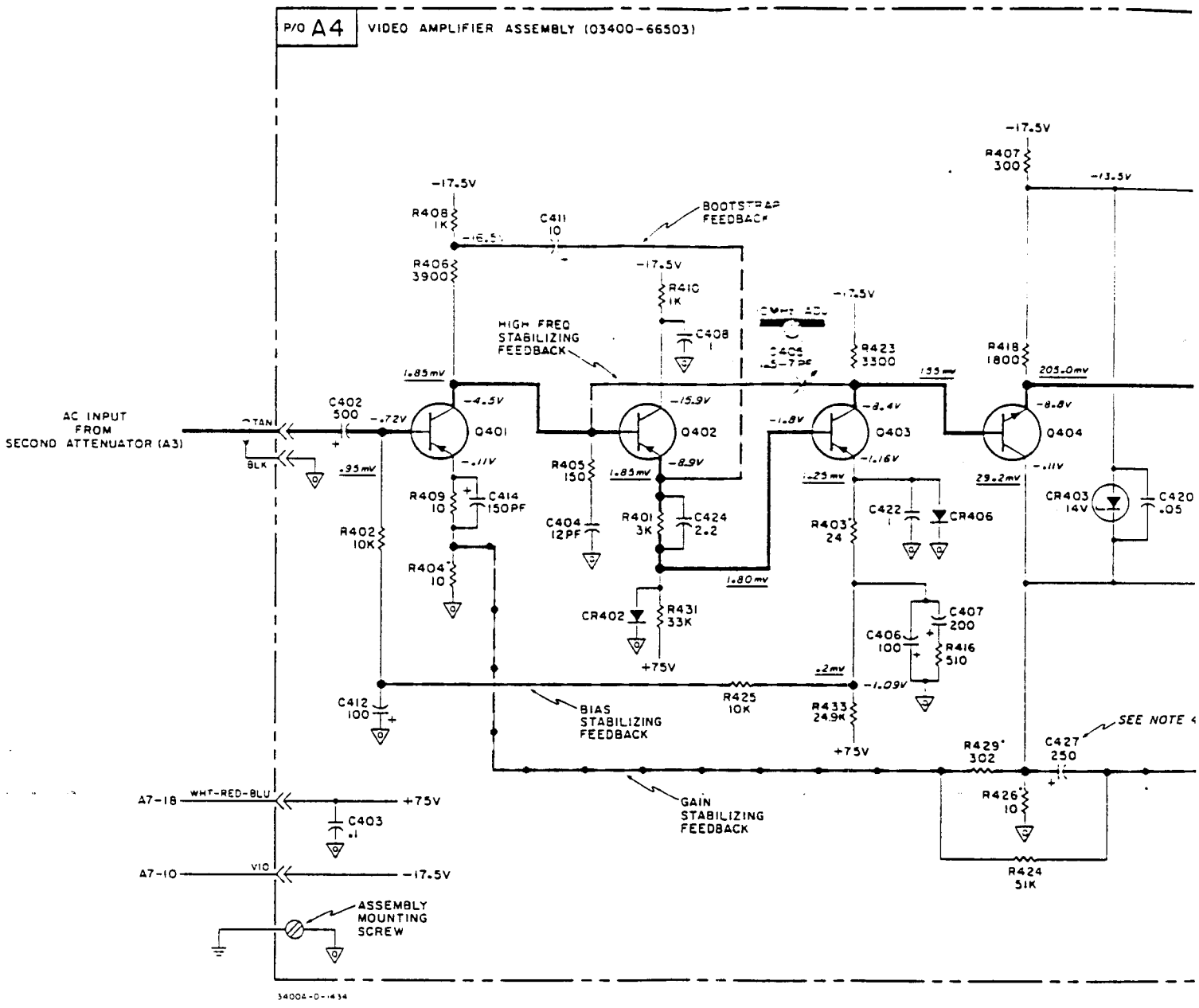
2. ALL AC VOLTAGES ARE UNDERLINED. ALL DC VOLTAGES HAVE A POLARITY INDICATION.



3400A-A-0107



A3
(-hp- Part No. 03400-63401)
(Board only)


P/O A4
VIDEO AMPLIFIER ASSEMBLY (03400-66503)
AC INPUT FROM SECOND ATTENUATOR (A3)
TAN
BLK
C402 500
-.72V
Q401
-4.5V
-.11V
.95mV
R402 10K
R409 10
C414 150PF
R404 10
-17.5V
R408 1K
-16.5V
C411 10
BOOTSTRAP FEEDBACK
R406 3900
HIGH FREQ STABILIZING FEEDBACK
1.85mV
R405 150
C404 12PF
Q402
-15.9V
-8.9V
R410 1K
C408
R401 3K
C424 2.2
1.80mV
CR402
R431 33K
+75V
-17.5V
C405 .5-7PF
R423 3300
Q403
-1.8V
-8.4V
-1.16V
1.25mV
R403 24
C422
CR406
C406 100
C407 200
R416 510
.2mV
-1.09V
R425 10K
R433 24.9K
+75V
C412 100
BIAS STABILIZING FEEDBACK
GAIN STABILIZING FEEDBACK
-17.5V
R407 300
-13.5V
R418 1800
205.0mV
Q404
-8.8V
-.11V
29.2mV
CR403 14V
C420 .05
SEE NOTE 4
R429 302
C427 250
R426 10
R424 51K
A7-18
WHT-RED-BLU
+75V
C403 .1
A7-10
VIO
-17.5V
ASSEMBLY MOUNTING SCREW
34004-0-1434

F

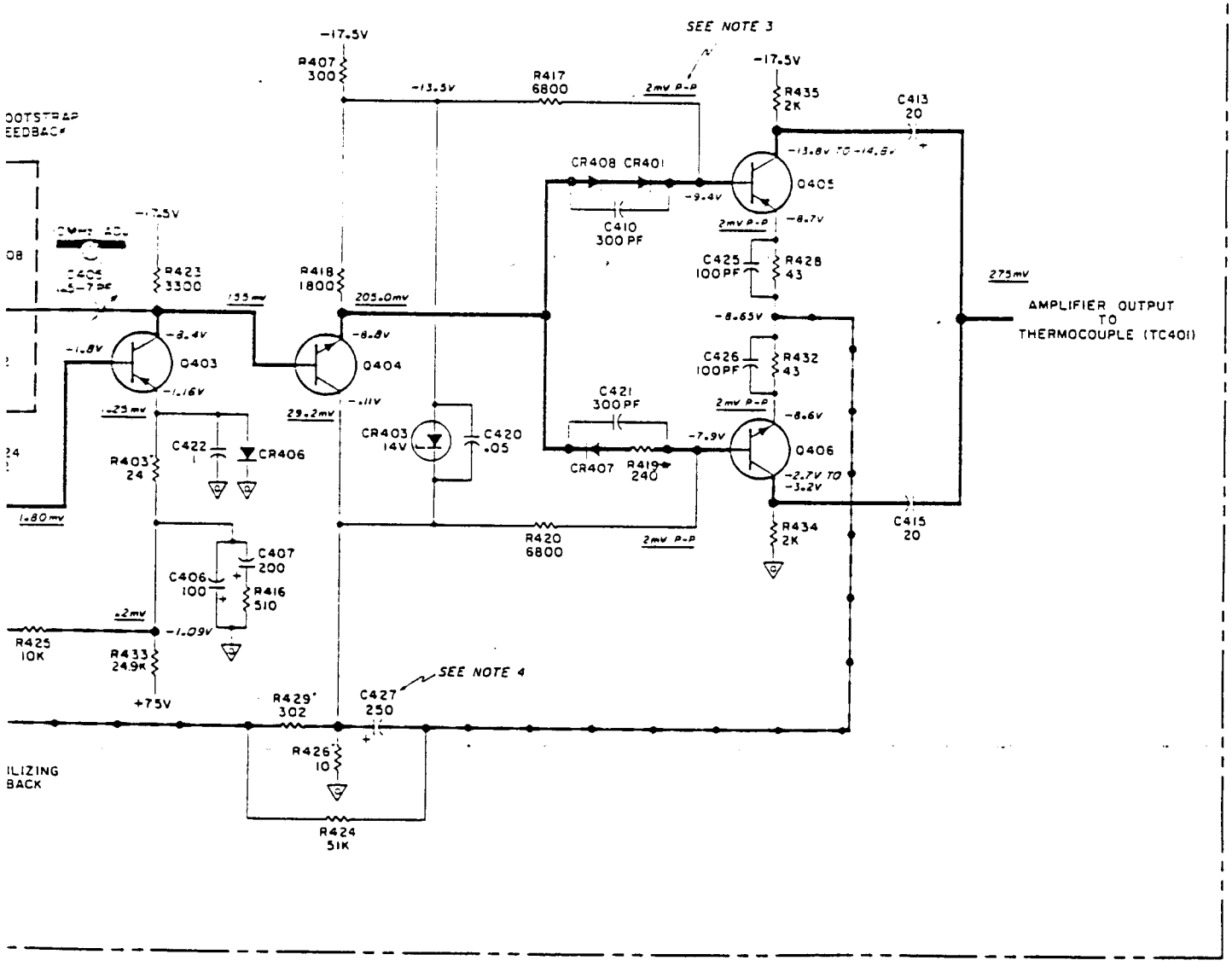
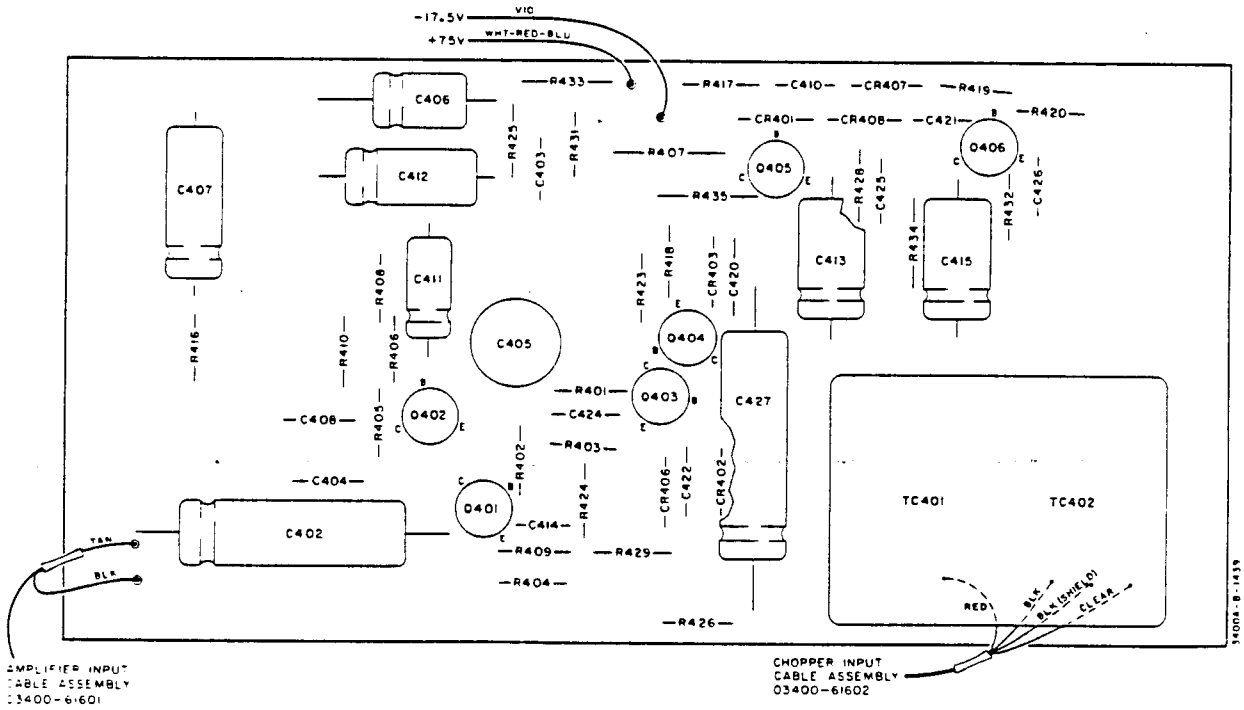


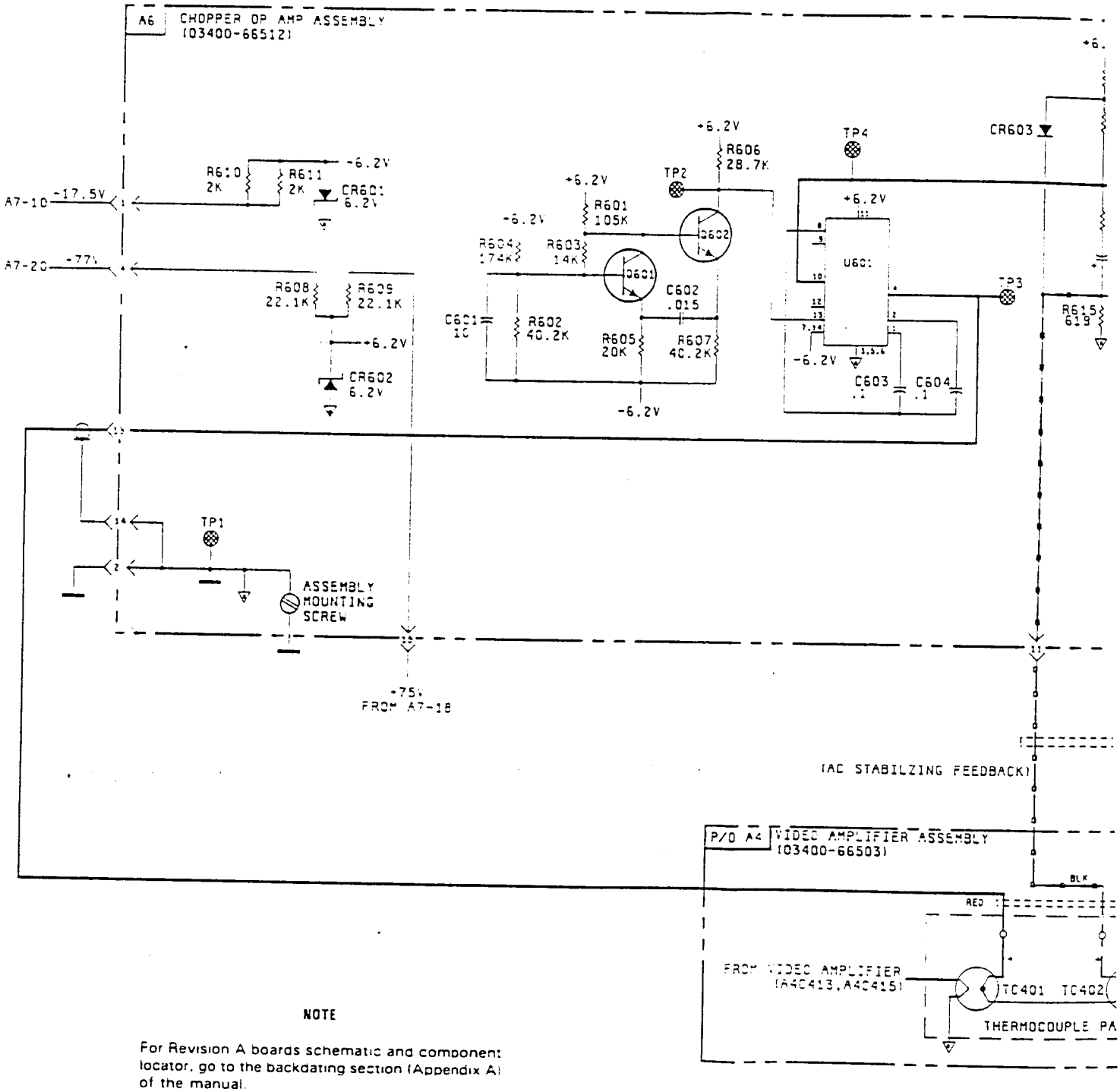
Figure 6-2. Video Amplifier A4 Schematic and Parts Location Diagram

NOTES

1. ALL DC AND AC VOLTAGE LEVELS SHOWN IN RED ARE WITH 1 MV INPUT (FULL SCALE DEFLECTION). A TOLERANCE OF ±10% SHOULD BE ALLOWED FOR VARIATIONS FROM INSTRUMENT TO INSTRUMENT.
2. ALL AC VOLTAGES ARE UNDERLINED. ALL DC VOLTAGES HAVE A POLARITY INDICATION.
3. AC VOLTAGE LEVELS AT Q405 AND Q406 MUST BE OBSERVED WITH 10:1 DIVIDER PROBE.
4. IF C427 IS REPLACED, IT MAY BE NECESSARY TO SELECT THE VALUE OF C427 FOR PROPER FREQUENCY RESPONSE. THIS IS DUE TO CAPACITOR TOLERANCE.



A4
(-hp- Part No. 03400-66503)



NOTE

For Revision A boards schematic and component locator, go to the backdating section (Appendix A) of the manual.

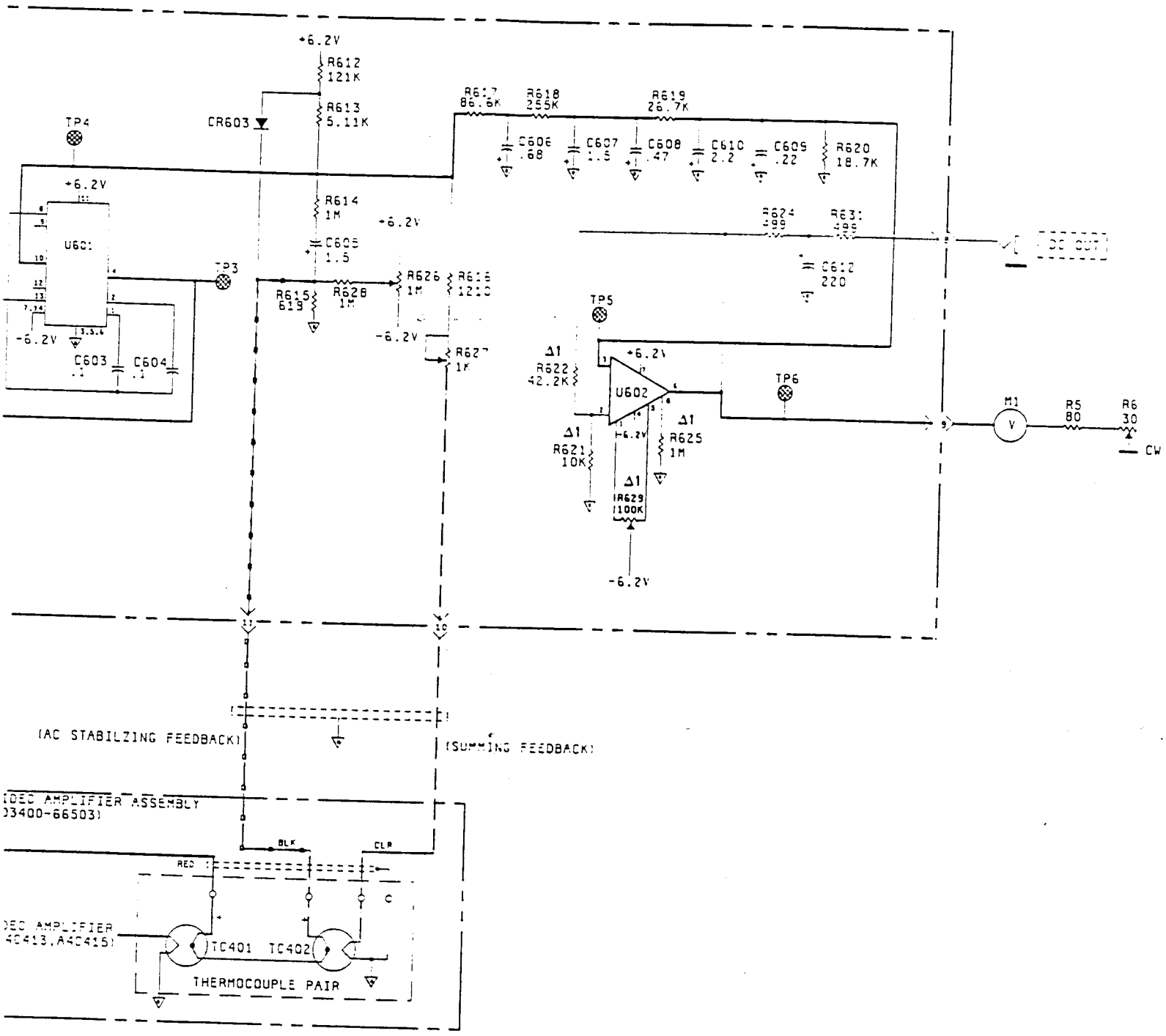
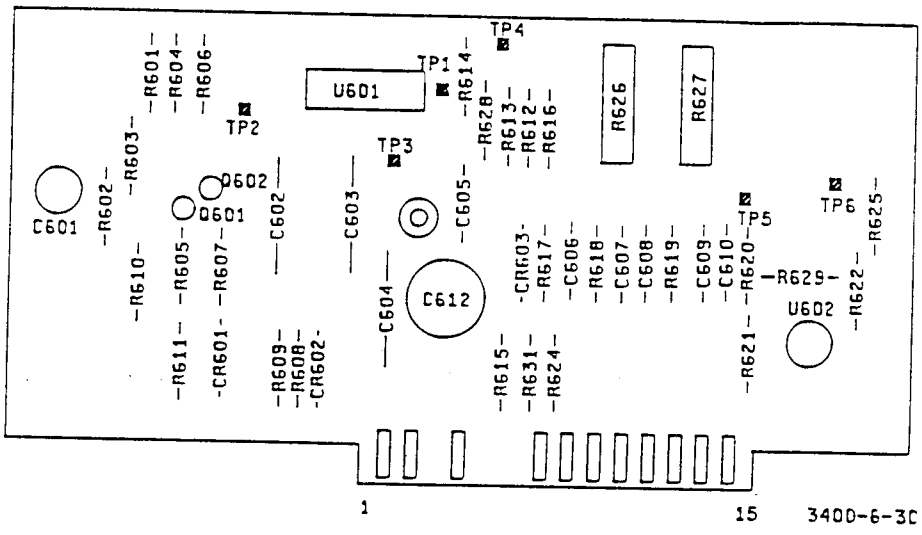
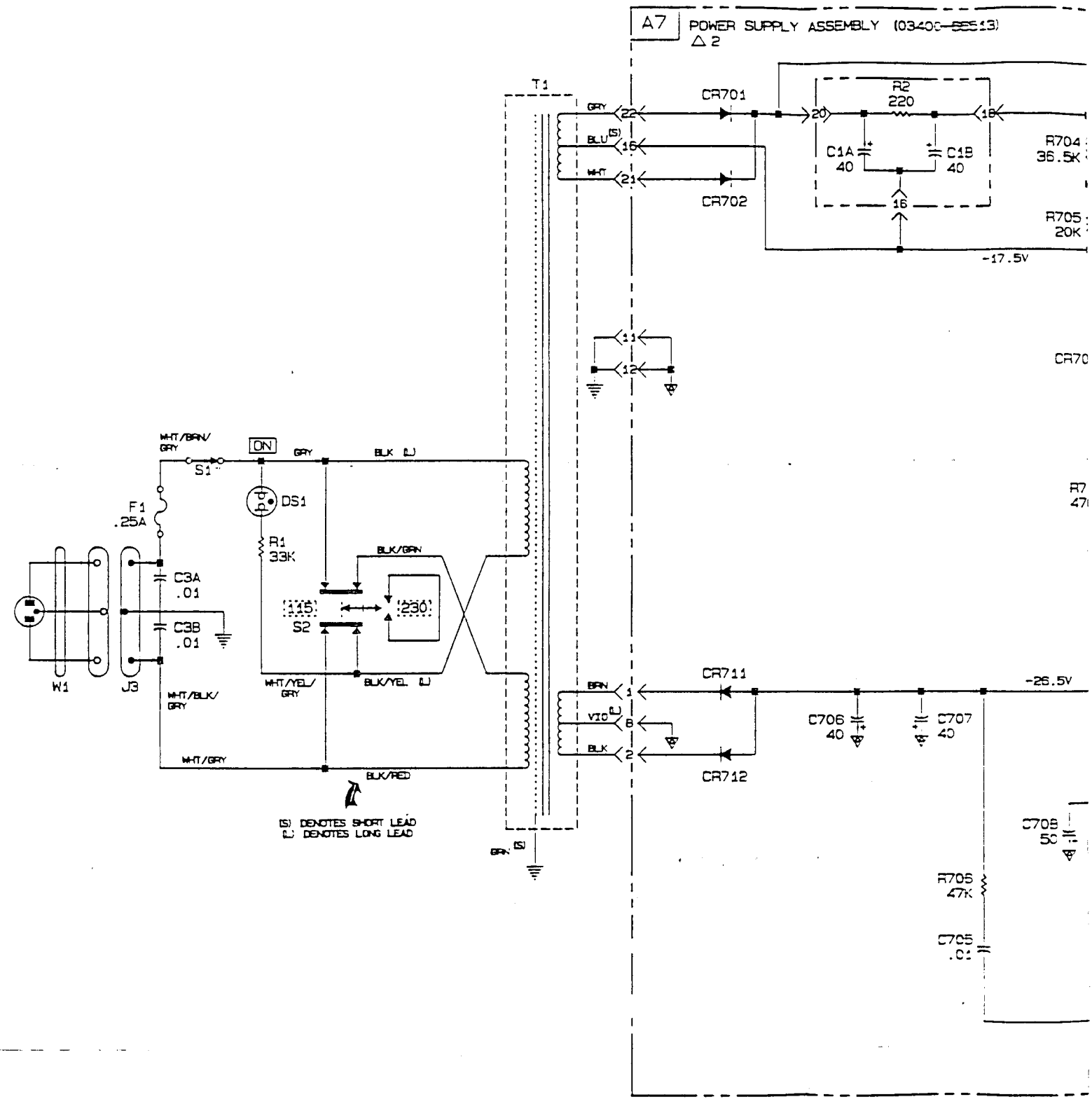


Figure 6-3. Chopper Amplifier A6 and Thermocouple Pair (Part of A4) Schematic and Parts Location Diagram



A6
(REV. C)
(hp Part Number 03400-66512) Δ1


A7 POWER SUPPLY ASSEMBLY (03400-66513)
△2
T1
CR701
CR702
R2
220
C1A
40
C1B
40
R704
36.5K
R705
20K
-17.5V
CR711
CR712
C706
40
C707
40
-26.5V
C708
50
R706
47K
C705
.01
WHT/BRN/
GRY
S1
ON
GRY
BLK (L)
F1
.25A
DS1
R1
33K
BLK/GRN
C3A
.01
C3B
.01
115
230
S2
W1
J3
WHT/YEL/
GRY
BLK/YEL (L)
WHT/BLK/
GRY
WHT/GRY
BLK/RED
(S) DENOTES SHORT LEAD
(L) DENOTES LONG LEAD

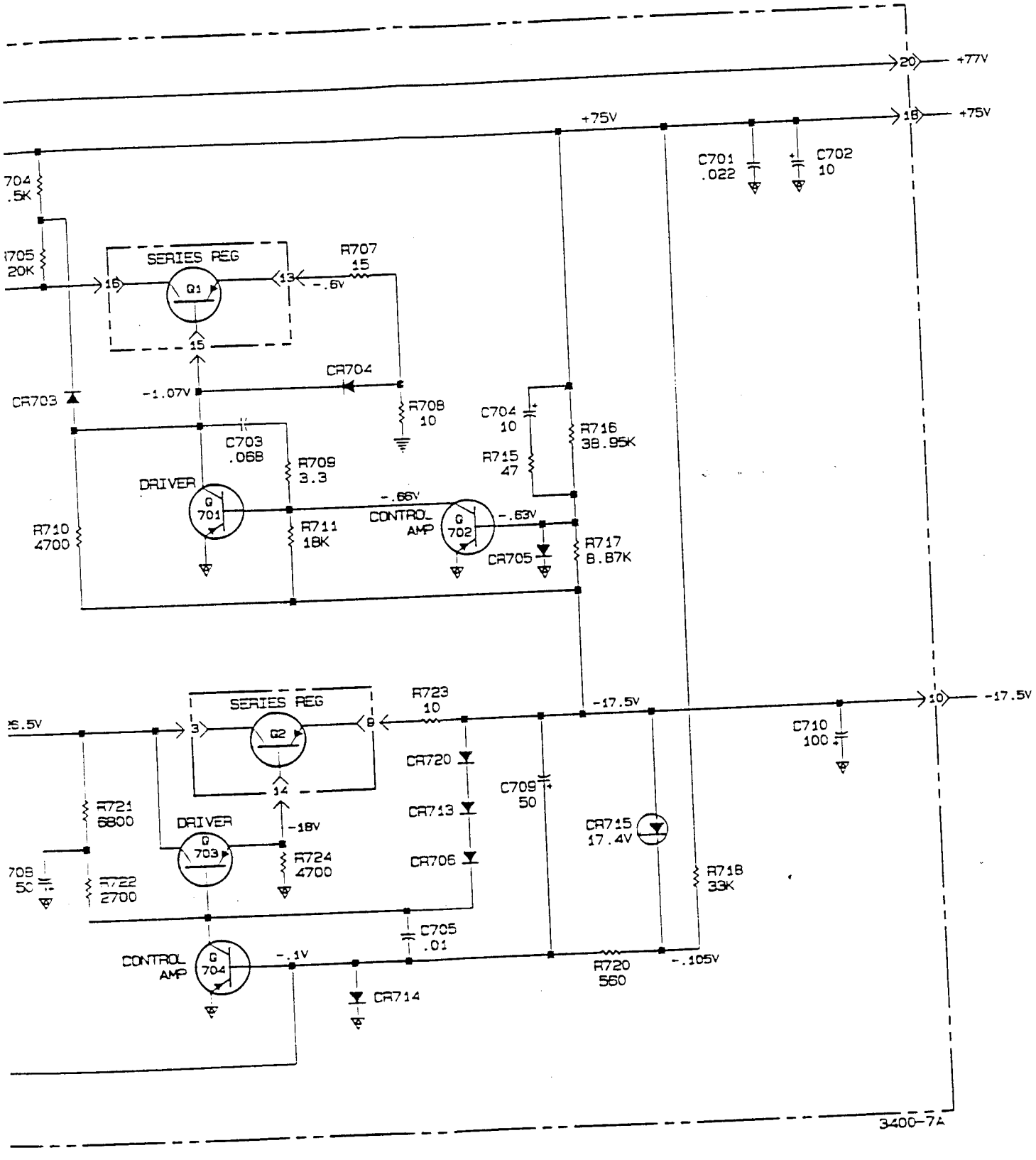
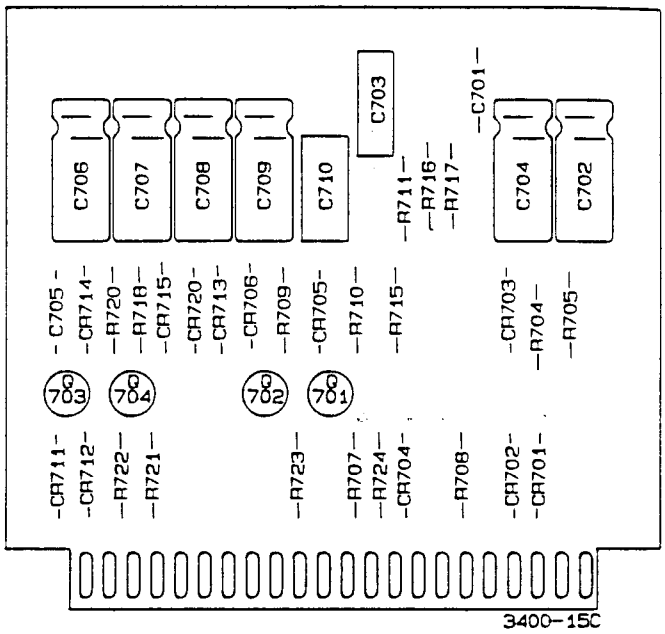


Figure 6-4. Power Supply A7 Schematic and Parts Location
6-9/6-10



A7
(-hp- Part No. 03400-66515) Δ2

SECTION VII
REPLACEABLE PARTS

7-1. INTRODUCTION

7-2. This section contains information for ordering replacement parts. Table 7-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number for each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five digit code.

d. Manufacturer's part number.

7-3. Miscellaneous parts are listed at the end of Table 7-1.

7-4. ORDERING INFORMATION

7-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

7-6. NON-LISTED PARTS

7-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

7-8. PARTS CHANGES

7-9. Components which have been changed are so marked by one of three symbols; i.e., Δ, Δ with a letter subscript, or Δ with a number subscript. A Δ with no subscript indicates the component is the preferred replacement for an earlier component. A Δ with a letter subscript indicates a change which is explained in a note at the bottom of the page. A Δ with a number subscript indicates a change which is discussed in backdating (Appendix A). The number of the subscript indicates the number of change in backdating which should be referred to.

Table 7-1. List of Abbreviations

ABBREVIATIONS

Ag	silver	Hz	hertz (cycle(s) per second)	NPO	negative positive zero (zero temperature coefficient)	sl	slide
Al	aluminum	ID	inside diameter	ns	nanosecond(s) = 10^{-9} seconds	SPDT	single-pole double-throw
A	ampere(s)	impg	impregnated	nsr	not separately replaceable	SPST	single-pole single-throw
Au	gold	incd	incandescent			Ta	tantalum
		ins	insulation(ed)	Ω	ohm(s)	TC	temperature coefficient
C	capacitor			obd	order by description	TiO_2	titanium dioxide
cer	ceramic	kΩ	kilohm(s) = 10^{3} ohms	OD	outside diameter	tog	toggle
coef	coefficient	kHz	kilohertz = 10^{3} hertz			tol	tolerance
com	common			p	peak	trim	trimmer
comp	composition	L	inductor	pA	picoampere(s)	TSTR	transistor
conn	connection	lin	linear taper	pc	printed circuit		
		log	logarithmic taper	pF	picofarad(s) 10^{-12} farads	V	volt(s)
dep	deposited			piv	peak inverse voltage	vacw	alternating current working voltage
DPDT	double-pole double-throw	mA	milliampere(s) = 10^{-3} amperes	p/o	part of	var	variable
DPST	double-pole single-throw	MHZ	megahertz = 10^{6} hertz	pos	position(s)	vdcw	direct current working voltage
		MΩ	megohm(s) = 10^{6} ohms	poly	polystyrene		
elect	electrolytic	met film	metal film	pot	potentiometer	W	watt(s)
encap	encapsulated	mfr	manufacturer	p-p	peak-to-peak	w/	with
		ms	millisecond	ppm	parts per million	wiv	working inverse voltage
F	farad(s)	mtg	mounting	prec	precision (temperature coefficient, long term stability and/or tolerance)	w/o	without
FET	field effect transistor	mV	millivolt(s) = 10^{-3} volts			ww	wirewound
fxd	fixed	μF	microfarad(s)				
		μs	microsecond(s)	R	resistor		
GaAs	gallium arsenide	μV	microvolt(s) = 10^{-6} volts	Rh	rhodium	*	optimum value selected at factory, average value shown (part may be omitted)
GHz	gigahertz = 10^{9} hertz	my	Mylar ®	rms	root-mean-square	**	no standard type number assigned selected or special type
gd	guarded			rot	rotary		
Ge	germanium	nA	nanoampere(s) = 10_{-9} amperes				® Dupont de Nemours
gnd	grounded	NC	normally closed	Se	selenium		
		Ne	neon	sect	section(s)		
H	henry(ies)	NO	normally open	Si	silicon		
Hg	mercury						

DESIGNATORS

A	assembly	FL	filter	Q	transistor	TS	terminal strip
B	motor	HR	heater	QCR	transistor-diode	U	microcircuit
BT	battery	IC	integrated circuit	R(p)	resistor(pack)	V	vacuum tube, neon bulb, photocell, etc.
C	capacitor	J	jack	RT	thermistor	W	cable
CR	diode or thyristor	K	relay	S	switch	X	socket
DL	delay line	L	inductor	T	transformer	XDS	lampholder
DS	lamp	M	meter	TB	terminal board	XF	fuseholder
E	misc electronic part	MP	mechanical part	TC	thermocouple	Y	crystal
F	fuse	P	plug	TP	test point	Z	network

Table 7-2. Code List of Manufacturers

Mfr. No.	Manufacturer Name	Address
00494	Addressograph Multigraph Corp.	Cleveland, OH 44117
01121	Allen-Bradley Co	Milwaukee, WI 53204
02111	Spectrol Electronics Corp	City of Ind, CA 91745
04713	Motorola Semiconductor Products	Phoenix, AZ 85008
13606	Sprague Elect Co Semiconductor Div	Concord, NH 03301
24546	Corning Glass Works (Bradford)	Bradford, Pa 16701
27014	National Semiconductor Corp	Santa Clara, CA 95051
28480	Hewlett-Packard Co Corporate Hq	Palo Alto, CA 94304
3L585	RCA Corp Solid State Div	Somerville, NJ
56289	Sprague Electric Co	North Adams, MA 01247
72136	Electro Motive Corp	Florence, SC 06226
72982	Erie Technological Products Inc	Erie, PA 16512
91637	Dale Electronics Inc	Columbus, NE 68601
91802	Industrial Devices Inc	Edgewater, NJ 07020

Table 7-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	03400-66501	0	1	ASSEMBLY-INPUT ATTENUATOR BOARD	28480	03400-66501
A2[2]	03400-66514	5	1	ASSEMBLY-IMPEDANCE CONVERTER BOARD	28480	03400-66514
A3	03400-63401	3	1	ASSEMBLY-SECOND ATTENUATOR	28480	03400-63401
A4	03400-66503	2	1	ASSEMBLY-AMPLIFIER BOARD	28480	03400-66503
A6[1]	03400-66512	3	1	ASSEMBLY-CHOPPER OP AMP	28480	03400-66512
A7[2]	03400-66515	6	1	ASSEMBLY-POWER SUPPLY BOARD	28480	03400-66514
C1	0180-0152	5	1	CAPACITOR-FXD 400UF+30-10% 200VDC AL	28480	0180-0152
C4	0160-0379	6	1	CAPACITOR-FDTHRU 4775PF 10% 500V MICA	72982	633-010 1BC1 47750
C101	0170-0022	7	1	CAPACITOR-FXD .1UF +-20% 600VDC POLYE	28480	0170-0022
C102	0132-0003	4	1	CAPACITOR-V TRMR-PSTN .7-3PF 350V	28480	0132-0003
C103	0150-0058	7	1	CAPACITOR-FXD 3.2PF +-.25PF 600VDC CER	28480	0150-0058
C200[2]	0160-2154	5	1	CAPACITOR-FXD .0022UF +-10% 200VDCW	56289	192P22292-PTS
C201[2]	0160 - 0166	1	3	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0166
C202[2]	0180 - 2825	1	5	CAPACITOR-FXD 22UF +50-10% 50VDC AL	28480	0180-2825
C203	0180-0060	4	2	CAPACITOR-FXD 200UF+75-10% 3VDC AL	56289	30D207G003CC2
C204[2]	0180-0116	1	1	CAPACITOR-FXD 6.8UF +-10% 35VDC TA	04200	150D685X9035B2
C205[2]	0180-0039	7	2	CAPACITOR-FXD 100UF+75-10% 12VDC AL	56289	30D107G012CC2
C302*	0160-0987	1	1	CAPACITOR-FXD 12PF+-10% 500VDC MICA	28480	0160-0987
C303	0121-0039	3	1	CAPACITOR-V TRMR-CER 8-50PF 350V PNL-MTG	72982	557-062 ER-50
C304*	0160-0987	2	2	CAPACITOR-FXD 12PF +-5% 500VDC MICA	28480	0160-0987
C305*	0160-0987	2		CAPACITOR-FXD 12PF +-5% 500VDC MICA	28480	0160-0987
C402	0180-0063	7	1	CAPACITOR-FXD 500UF+75-10% 3VDC AL	56289	30D507G003DF2
C403	0160-0269	3	1	CAPACITOR-FXD .1UF +-20% 500VDC CER	28480	0160-0269
C404	0140-0201	1	1	CAPACITOR-FXD 12PF +-5% 500VDC MICA	72136	DM15C120J0500WV1CR
C405	0130-0018	7	1	CAPACITOR-V TRMR-CER 1.5-7PF 350V PC-MTG	28480	0130-0018
C406	0180-0137	6	1	CAPACITOR-FXD 100UF+-20% 10VDC TA	56289	150D107X0010R2
C407	0180-0060	4		CAPACITOR-FXD 200UF+75-10% 3VDC AL	56289	30D207G003CC2
C408	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C410	0140-0225	9	2	CAPACITOR-FXD 300PF +-1% 300VDC MICA	72136	DM15F301F0300WV1C
C411	0180-0224	2	1	CAPACITOR-FXD 100UF+75-10% 16VDC AL	56289	30D106G016BA2
C412	0180-0039	7		CAPACITOR-FXD 100UF+75-10% 12VDC AL	56289	30D107G012CC2
C413	0180-0142	3	2	CAPACITOR-FXD 20UF+100-10% 25VDC AL SPOL	28480	0180-0142
C414	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
C415	0180-0142	3		CAPACITOR-FXD 20UF+100-10% 25VDC AL SPOL	28480	0180-0142
C420	0150-0096	3	1	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0150-0096
C421	0140-0225	9		CAPACITOR-FXD 300PF +-1% 300VDC MICA	72136	DM15F301F0300WV1C
C422	0160-0127	3		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C424	0160-0128	3	1	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
C425	0140-0176	9	2	CAPACITOR-FXD 100PF +-2% 300VDC MICA	72136	DM15F101G0300WV1CR
C426	0140-0176	9		CAPACITOR-FXD 100PF +-2% 300VDC MICA	72136	DM15F101G0300WV1CR
C427*	0180-2428	2	1	CAPACITOR-FXD 250UF+75-10% 25VDC AL	56289	500D257G025EF7
C601	0180-2822	0	1	CAPACITOR-FXD 10UF+50-10% 50VDC AL	28480	0180-2822
C602	0160-0194	3	1	CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
C603	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
C604	0160-0168	1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
C605	0180-1745	4	2	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
C606	0180-0373	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
C607	0180-1745	4		CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
C608	0180-0376	5	1	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
C609	0180-1735	2	1	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
C610	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C612	0180-0692	8	1	CAPACITOR-FXD 220UF+50-10% 35VDC AL	00494	35VBSL220
C701	0170-0024	9	1	CAPACITOR-FXD .022UF +-20% 200VDC POLYE	28480	0170-0024
C702	0180-0089	7		CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C703	0160-0166	9	1	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
C704	0180-0089	7		CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C705	0150-0012	3	1	CAPACITOR-FXD .01UF +-20% 1KVDC CER	56289	C023A102J103MS38
C706	0180-0050	2	2	CAPACITOR-FXD 40UF+75-10% 50VDC AL	56289	30D406G050DD2
C707	0180-0050	2		CAPACITOR-FXD 40UF+75-10% 50VDC AL	56289	30D406G050DD2
C708	0180-0105	8	2	CAPACITOR-FXD 50UF+100-10% 25VDC AL SPOL	28480	0180-0105
C709	0180-0105	8		CAPACITOR-FXD 50UF+100-10% 25VDC AL SPOL	28480	0180-0105
C710	0180-0098	8	1	CAPACITOR-FXD 100UF+-20% 20VDC TA	56289	150D107X0020S2
CR201[2]	1901-0050	3	2	DIODE-SWITCHING 80 V 200MA 2NS DO-35	28480	1901-0050
CR202[2]	1901-0050	3		DIODE-SWITCHING 80 V 200MA 2NS DO-35	28480	1901-0050
CR203[2]	1902-0964	0	1	DIODE-ZNR 18 V 5%	28480	1902-0964
CR204[2]	1901-0025	2	10	DIODE-GEN PRP 100 V 200MA DO-7	28480	1901-0025
CR205[2]	1901-0025	2		DIODE-GEN PRP 100 V 200MA DO-7	28480	1901-0025
CR206[2]	1901-0025	2		DIODE-GEN PRP 100 V 200 MA DO-7	28480	1901-0025
CR401	1901-0025	2		DIODE-GEN PRP 100 V 200MA DO-7	28480	1901-0025
CR402	1901-0040	3		DIODE-SWITCHING 30 V 50MA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information
*Indicates factory selected value

Table 7-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CR406	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR407	1910-0016	0	2	DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
CR408	1910-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
CR601	1902-0777	3	2	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR602	1902-0777	3		DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR603	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
CR701	1901-0028	5	2	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
CR702	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
CR703	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR704	1901-0701	1	2	DIODE-STABISTOR 12V 10MA	28480	1901-0701
CR705	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR706	1901-0701	1		DIODE-STABISTOR 12V 10MA	28480	1901-0701
CR711	1901-0026	3	2	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR712	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR713	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR714	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR715	1902-3223	0	1	DIODE-ZNR 17.4V 2% DO-35 PD=.4W	28480	1902-3223
CR717	1901-0045	6		DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
CR720	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
DS1	1450-0566	9	1	LIGHT-IND WHT-TL .4-DIA SLDR-LUG-TERM	91802	2910521
F1	2110-0004	1	1	FUSE .25A 250V NTD 1.25X.25 UL	28480	2110-0004
J1	1250-0118	3	1	CONNECTOR-RF BNC FEM SQL-HOLE-FR 50-OHM	28480	1250-0118
J2	1251-0205	1	1	CONNECTOR-TEL JACK 2-CKT .25-SHK-DIA	28480	1251-0205
J3	1251-2357	8	1	CONNECTOR-AC PWR HP-9 MALE FLG-MTG	28480	1251-2357
J4	1251-0208	4	1	CONNECTOR-PC EDGE 22-CONT/ROW 1-ROW	28480	1251-0208
J5	1251-0194	7	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-0194
M1	1120-0320	4	1	METER- 3MA	28480	1120-0320
M1	1120-0308	8	1	METER-DB SCALE (OPT. 001 ONLY)	28480	1120-0308
Q1	1853-0063	5	1	TRANSISTOR PNP SI TO-3 PD=150W FT=3MHZ	28480	1853-0063
Q2	1853-0305	8	1	TRANSISTOR PNP 2N5875 SI TO-3 PD=150W	04713	2N5875
Q201A2	1855-0410	0	1	TRANSISTOR FET	28480	1855-0410
Q202A2	185--0005	1	1	TSTR NPN 2N709 SI	28480	185--0005
Q401	1853-0288	6	4	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q402	1853-0288	6		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q403	1853-0288	6		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q404	1854-0354	9	2	TRANSISTOR NPN SI TO-52 PD=360MW	28480	1854-0354
Q405	1853-0288	6		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q406	1854-0354	9		TRANSISTOR NPN SI TO-52 PD=360MW	28480	1854-0354
Q601	1854-0226	4	2	TRANSISTOR NPN 2N4384 SI TO-18 PD=500MW	13606	2N4384
Q602	1854-0226	4		TRANSISTOR NPN 2N4384 SI TO-18 PD=500MW	13606	2N4384
Q701	1853-0066	8	2	TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
Q702	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
Q703	1853-0086	2	2	TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
Q704	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
R1	0687-3331	2	1	RESISTOR 33K 10% .5W CC TC=0+765	01121	EB3331
R2	0687-2211	5	1	RESISTOR 220 10% .5W CC TC=0+529	01121	EB2211
R5	0812-0048	9	1	RESISTOR 80 3% .75W PW TC=0+-20	91637	RS1/2-T9-80R-H
R6	2100-0721	8	1	RESISTOR-TRMR 30 20% WW SIDE-ADJ 1-TRN	28480	2100-0721
R101	0698-4128	0	1	RESISTOR 10M .25% 1W F TC=0+-50	28480	0698-4128
R103	0698-6204	7	1	RESISTOR 9.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9901-F
R104	2100-0554	5	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
R200A2	0683-6215	9	2	RESISTOR 620 5% .25W FC TC =-400/+700	01121	CB6215
R201A2	0683-6215	9		RESISTOR 620 5% .25W FC TC =-400/+700	01121	CB6215
R202A2	0764-0043	1	1	RESISTOR 2.7K 5% 2W MO TC=0+-200	28480	0764-0043
R203A2	0698-3572	8	1	RESISTOR 60.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6042-F
R204A2	0698-3499	6	1	RESISTOR 40.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
R205A2	0683-3355	2	1	RESISTOR 3.3M 5% .25W FC TC=-900/+1200	01121	CB3355
R206A2	0698-1535	7	2	RESISTOR 16K 5% .25W FC TC=-400/+800	01607	CB1635
R207A2	0698-1635	7		RESISTOR 16K 5% .25W FC TC=-400/+800	01607	CB1635
R208A2	0698-4459	0	1	RESISTOR 634 1% .125W F TC=0+-100	24546	C4-1/8-T0-6340-F
R209A2	0698-4484	1	1	RESISTOR 19.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1912-F
R210 A2	0698-4125	7	1	RESISTOR 953 1% .125W	19701	MFSC T-0
R211	0757-0281	3	1	RESISTOR 2.74K 1% .125W TC=0+-100	24546	C4-1/8-T0-2741-F
R301	0757-0715	9	1	RESISTOR 150 1% .25W F TC=0+-100	24546	C5-1/4-T0-151 -F
R302	0698-4119	9	5	RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119
R303	0698-4118	8	4	RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R304	0698-4119	9		RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119
R305	0698-4118	8		RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R306	0698-4119	9		RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119

See introduction to this section for ordering information
*Indicates factory selected value

Table 7-3. Replaceable Parts (Cont'd)

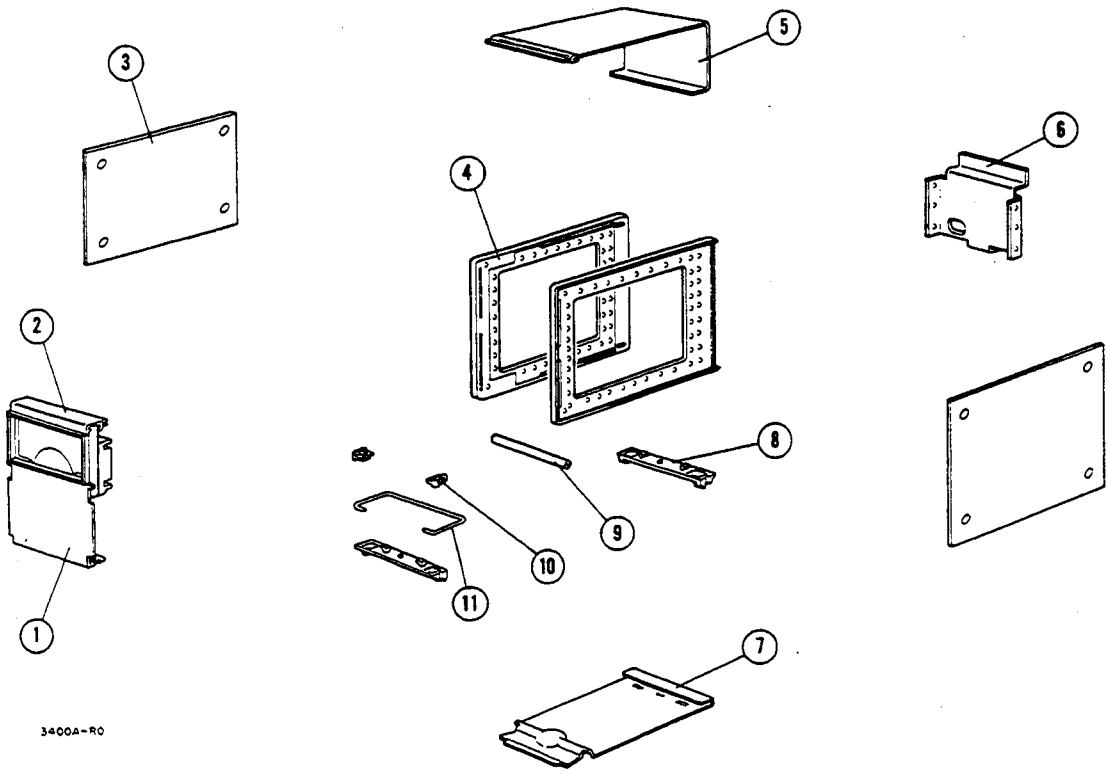
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R307	0698-4118	8		RESISTOR 277.4Ω .1% .25W F TC=0+100	28480	0698-4118
R308	0698-4119	9		RESISTOR 410.2Ω .1% .25W F TC=0+100	28480	0698-4119
R309	0698-4118	8		RESISTOR 277.4Ω .1% .25W F TC=0+100	28480	0698-4118
R310	0698-4119	9		RESISTOR 410.2Ω .1% .25W F TC=0+100	28480	0698-4119
R311	0698-4117	7	1	RESISTOR 169.7Ω .1% .25W F TC=0+100	28480	0698-4117
R312	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
R401	0683-3025	3	1	RESISTOR 3K 5% .25W FC TC=-400/+700	01121	CB3025
R402	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R403*	0683-2405	1	1	RESISTOR 24 5% .25W FC TC=-400/+500	01121	CB2405
R404*	0757-0346	2	3	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R405	0683-1515	2	1	RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
R406	0683-3925	2	1	RESISTOR 3.9K 5% .25W FC TC=-400/+700	01121	CB3925
R407	0727-0065	9	1	RESISTOR 300 1% .5W CF TC=0-500	28480	0727-0065
R408	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R409	0683-1005	5	1	RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R410	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R416	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
R417	0683-6825	7	3	RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R418	0683-1825	7	1	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
R419*	0683-2415	3	1	RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
R420	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R423	0683-3325	6	1	RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R424	0683-5135	0	1	RESISTOR 51K 5% .25W FC TC=-400/+800	01121	CB5135
R425	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R426*	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R428	0683-4305	4	2	RESISTOR 43 5% .25W FC TC=-400/+500	01121	CB4305
R429*	0757-0345	1	1	RESISTOR 302 1% .125W F TC=0+-100	24546	C4-1/8-T0-302R-F
R431	0683-3335	8	2	RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
R432	0683-4305	4		RESISTOR 43 5% .25W FC TC=-400/+500	01121	CB4305
R433	0698-3217	6	1	RESISTOR 24.9K 1% .25W F TC=0+-100	24546	C5-1/4-T0-2492-F
R434	0757-0739	7	2	RESISTOR 2K 1% .25W F TC=0+-100	24546	C5-1/4-T0-2001-F
R435	0757-0739	7		RESISTOR 2K 1% .25W F TC=0+-100	24546	C5-1/4-T0-2001-F
R601	0698-4524	0	1	RESISTOR 174K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1743-F
R602	0698-3499	6	2	RESISTOR 40.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
R603	0698-4479	4	1	RESISTOR 14K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
R604	0698-4514	8	1	RESISTOR 105K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1053-F
R605	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
R606	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
R607	0698-3499	6		RESISTOR 40.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
R608	0757-0450	9	2	RESISTOR 22.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2212-F
R609	0757-0450	9		RESISTOR 22.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2212-F
R610	0683-2025	1	2	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R611	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R612	0757-0467	8	1	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
R613	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
R614	0698-7332	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
R615	0757-0274	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-61R9-F
R616	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
R617	0698-4511	5	1	RESISTOR 86.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8662-F
R618	0698-3149	3	1	RESISTOR 255K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2553-F
R619	0698-4488	5	1	RESISTOR 26.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2672-F
R620	0698-4483	0	1	RESISTOR 18.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1872-F
R621‡	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R622‡	0698-3450	9	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
R624	0698-4123	5	2	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R625‡	0698-7332	4	1	RESISTOR 1M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1004-F
R626	2100-3163	8	1	RESISTOR-TRMR 1M 20% C SIDE-ADJ 17-TRN	02111	43P105
R627	2100-3154	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
R628	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
R629‡	2100-3355	0	1	RESISTOR-TRMR 100K 10%	28480	2100-3355
R631	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R704	0757-0765	9	1	RESISTOR 36.5K 1% .25W F TC=0+-100	24546	C5-1/4-T0-3652-F
R705	0683-2035	3	1	RESISTOR 20K 5% .25W FC TC=-400/+800	01121	CB2035
R707‡	0683-1505	0	1	RESISTOR 5% .25W FC TC=-400/+500	01121	CB1505
R708‡	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R711	0687-1831	3	1	RESISTOR 18K 10% .5W CC TC=0+765	01121	EB1831
R715	0683-4705	8	1	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R716	0727-0188	7	1	RESISTOR 38.95K .5% .5W CF TC=0-500	91637	DC51/2-3895-D
R717	0698-4135	6	1	RESISTOR 8.87K 1% .5 CF TC=0-50	28480	0698-4135
R718	0683-3335	8		RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
R720	0683-5615	1	1	RESISTOR 560 5% .25W FC TC=-400/+600	01121	CB5615
R721	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R722	0683-2725	8	1	RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R723	0684-1001	3	1	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
R724	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725

See introduction to this section for ordering information
*Indicates factory selected value

Table 7-3. Replaceable Parts (Cont'd)

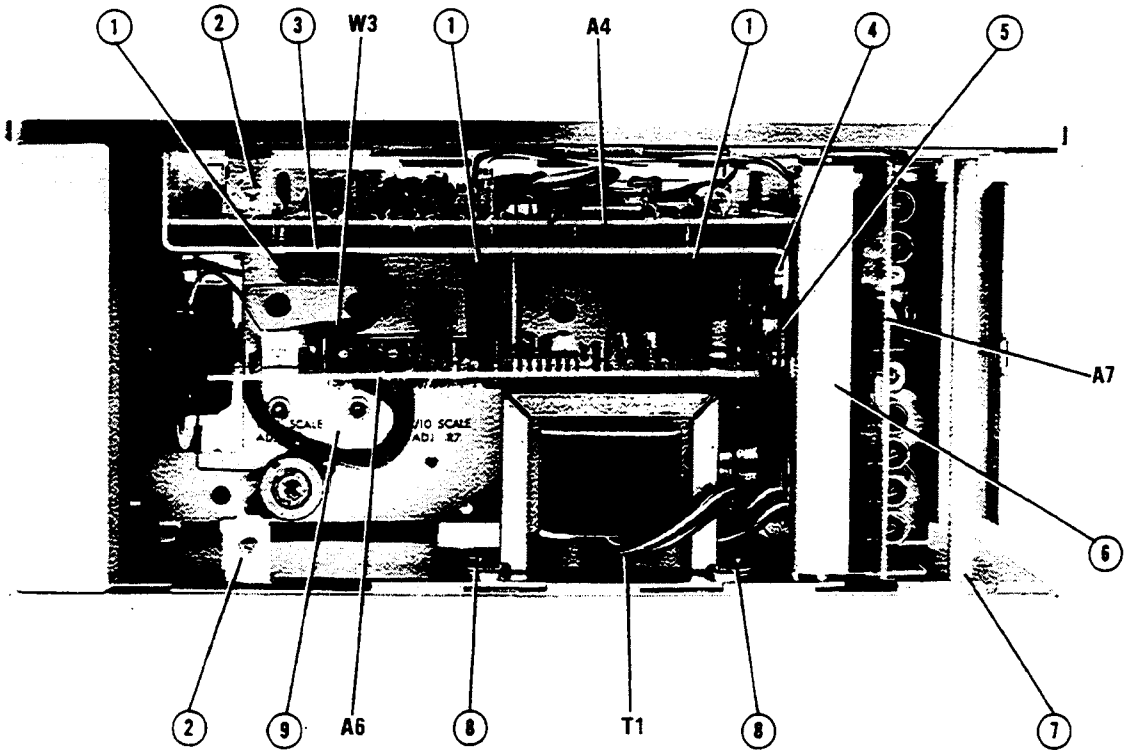
Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
S1	3101-0036	1	1	SWITCH-TGL BASIC SPST 3A 250VAC/DC	28480	3101-0036
S2	3101-1234	3	1	SWITCH-SL DPDT STD 1.5A 250VAC SLDR-LUG	28480	3101-1234
S301	3100-0358	8	1	SWITCH-ROTARY 1.250 STRUT CTR SPCG; 12	28480	3100-0358
T1*	9100-4362	8	*	TRANSFORMER-POWER (SEE NOTE BELOW)	28480	9100-4362
TC401	0853-0003	2	2	THERMOCOUPLE-PR.	28480	0853-0003
TC402	0853-0003	2		THERMOCOUPLE-PR.	28480	0853-0003
U501	1826-0968	2	1	IC-OPERATIONAL AMPLIFIER	28480	1826-0968
U402	1826-0310	8	1	IC-OPERATIONAL AMPLIFIER	28480	1826-0310
W1	8120-1348	5	1	CABLE ASSY 18AWG 3-CNDCT BLK-JKT	28480	8120-1348
XF1	1400-0084	1	1	FUSEHOLDER-EXTR POST 15A 250 V UL	28480	1400-0084
	1200-0044	9	2	SOCKET-XSTR 2-CONT TO-3	28480	1200-0044
				MISCELLANEOUS		
	0370-0077	6	1	KNOB SKRTD BAR:BLK:FOR .250SHFT:.625D	28480	0370-0077
	0340-0580	5	1	INSULATOR-XSTR	28480	0340-0580
	1520-0002	7	1	PLATE-MOUNTING FOR TWIST LOCK TYPE CAP	28480	1520-0002
	1520-0003	8	1	PLATE-MOUNTING FOR TWIST LOCK TYPE CAP	28480	1520-0003
	03400-01202	2	1	CLAMP-CAPACITOR MOUNTING	28480	03400-01202
	03400-01204	4	1	BRACKET-GROUND	28480	03400-01204
	03400-61601	1	1	CABLE ASSEMBLY-AMPLIFIER INPUT	28480	03400-61601
	03400-61602	2	1	CABLE ASSEMBLY-CHOPPER INPUT	28480	03400-61602
	03400-61603	3	1	CABLE ASSEMBLY-INPUT ATTENUATOR	28480	03400-61603
	03400-69501	6	1	SHOCK MOUNT IMPEDANCE CONVERTER	28480	03400-69501
	1200-0041	6	2	SOCKET-XSTR TO-3	28480	1200-0044
W2	03400-61601	1	1	CABLE ASSEMBLY-AMPLIFIER INPUT	28480	03400-61601
W3	03400-61602	2	1	CABLE ASSEMBLY-CHOPPER INPUT	28480	03400-61602
W4	03400-61603	3	1	CABLE ASSEMBLY-INPUT ATTENUATOR	28480	03400-61603
	NOTE: SOME INSTRUMENTS HAVE POWER TRANSFORMERS (T1) WITH -HP- PART NUMBER 9100-1446. REPLACE WITH NEW PART NUMBER.					

See introduction to this section for ordering information
*Indicates factory selected value



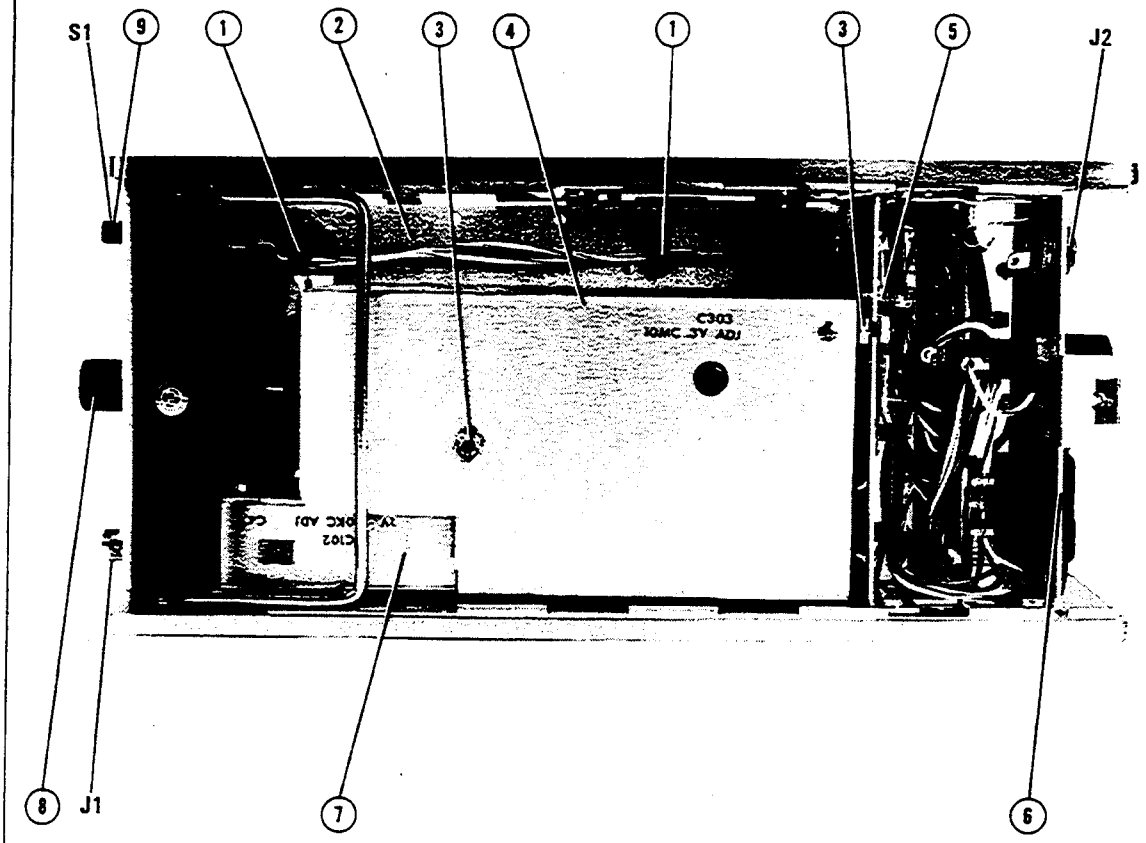
Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	03400-00204	2	1	Front Panel
2	5020-6852	1	1	Meter Trim ⅓ Module
3	5000-8565	5	2	Side Cover 6 x 11 sm
4	5060-0703	3	2	Frame Assembly
5	03400-64103	4	1	Top Cover (with handle)
6	03400-00215	5	1	Rear Panel
7	5000-8571	3	1	Buttom Cover 5 x 11 sm
8	5060-0727	1	2	Foot Assembly ⅓ Module
9	5020-0700	6	2	Spacer ⅓ Module
10	5040-0700	8	2	Hinge
11	1490-0031	7	1	Tilt Stand ⅓ Module

Figure 7-1. Modular Cabinet



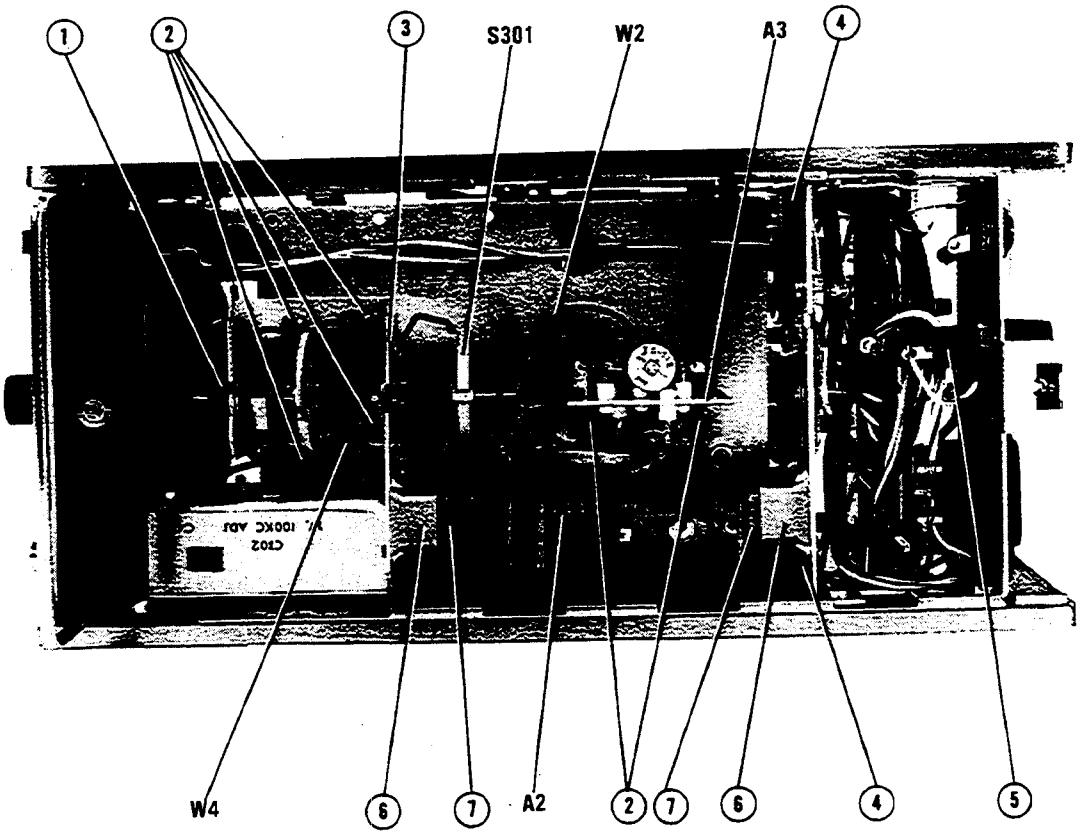
Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	2360-0115	4	3	Screws 6-32 .312 Lock Pozi
2	0590-0052	3	2	Nut-Sheet Metal .5TH
2	5040-0700	8	2	Hinge
3	03400-00601	3	1	Amplifier Shield
A4	03400-66503	2	1	Amplifier Board
4	2360-0201	9	1	Screw 6-32 .5 Pozi
4	2190-0006	1	1	Washer Lock
4	3050-0066	8	1	Washer Flat
4	3050-0005	5	1	Washer Shoulder Fiber
4	3050-0003	3	2	Washer Flat Fiber
5	1200-0041	6	2	Transistor Socket
5	0340-0580	3	2	Transistor Insulator
5	0624-0034	4	4	Screw 6-20 Phillips
5	2190-0008	3	4	Washer Lock
$A7\Delta_2$	03400-66515	6	1	Power Supply Board
$6\Delta_2$	03400-00103	0	1	Chassis Rear
7	5020-0700	6	1	Spacer ⅓ Module
8	2360-0113	2	2	Screw 6-32 .25 Lock Pozi
$T1\Delta_2$	9100-4362	8	1	Power Transformer
$A6\Delta_1$	03400-66512	3	1	Chopper Amplifier Board
9	03400-00101	8	1	Chassis Main
W3	03400-61602	2	1	Cable Assembly-Chopper Input

Figure 7-2 3400A Top View



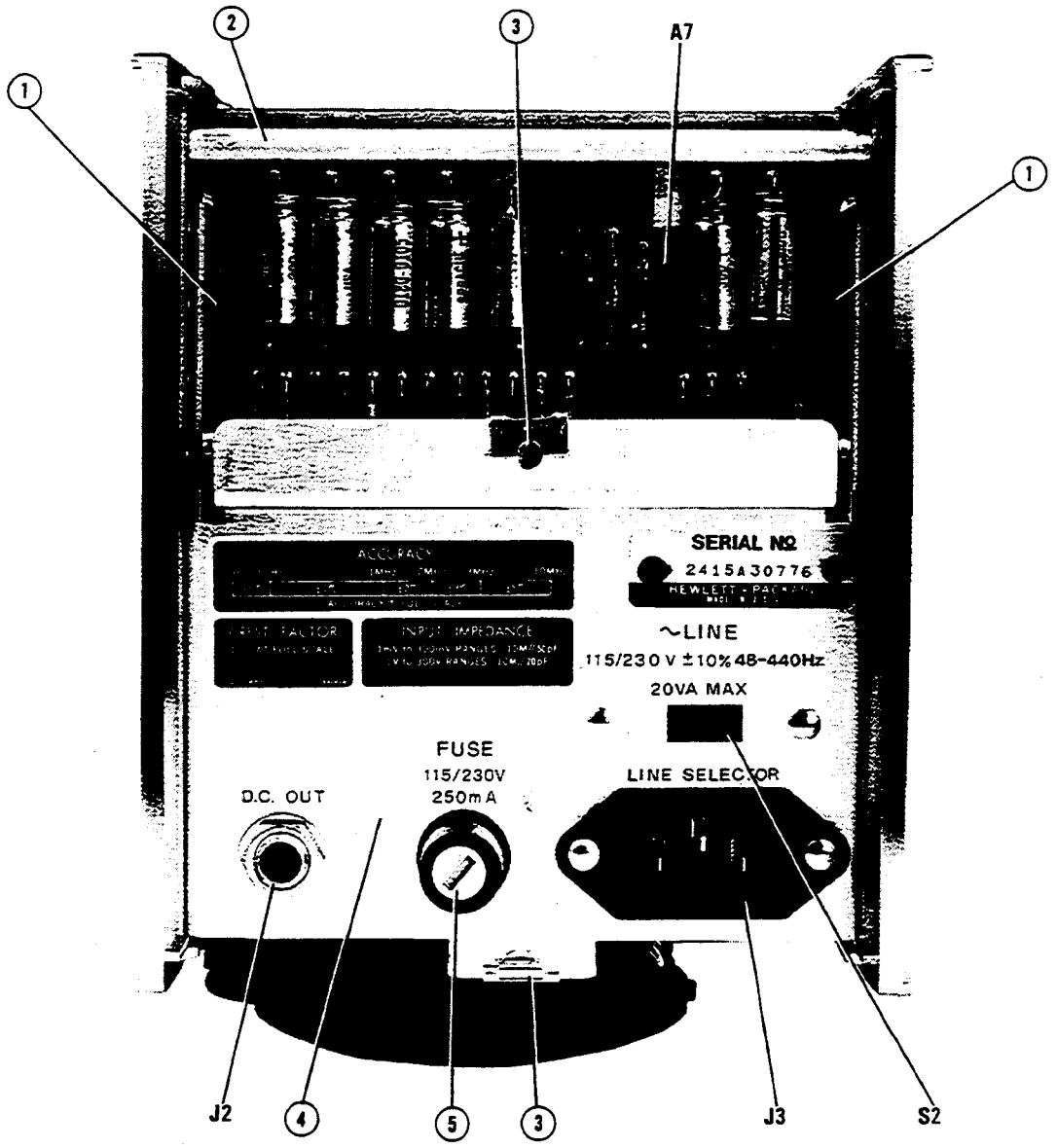
Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	1400-0116	0	2	Wire Clamp
2	03400-00101	8	1	Chassis Main
3	2420-0001	5	3	Nut 6-32 Hex Lock
4	03400-00602	4	1	Attenuator Shield
5	2360-0115	4	1	Screw 6-32 .312 Lock Pozi
5	2420-0001	5	1	Nut 6-32 Hex Lock
5	0360-0042	4	1	Solder Lug
J2	1251-0205	1	1	DC Out Jack
6	03400-00215	5	1	Rear Panel
7	03400-05501	2	1	Can Shield
J1	1250-0118	3	1	Input Connector
8	5040-4025	8	1	Knob
8	1410-0082	0	1	Knob Bushing
S1	3101-2147	9	1	Power Switch
9	2950-0001	8	1	Nut Hex Double Cham
9	2190-0099	2	1	Washer Lock Intl T

Figure 7-3 3400A Bottom View



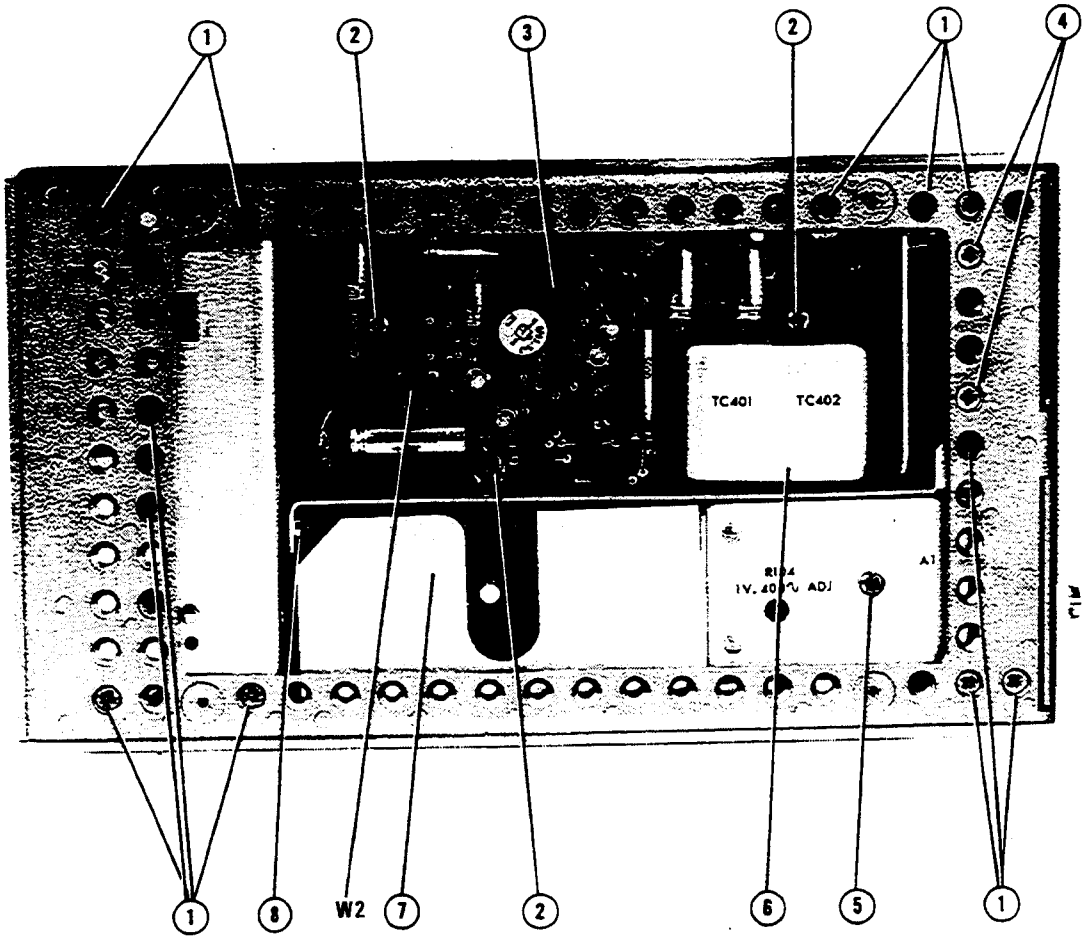
Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	2950-0001	8	1	Nut Hex Double Cham
1	2190-0022	1	1	Washer Lock Intl T
2	2360-0115	4	6	Screw 6-32 .312 Lock Pozi
S301	3100-0358	8	1	Range Switch
3	03400-01201	1	1	Range Switch Bracket
W2	03400-61601	1	1	Cable Assembly-Amplifier Input
A3	03400-63401	3	1	Second Attenuator
4	2360-0201	9	2	Screw 6-32 .5 Pozi
4	2190-0006	1	2	Washer Lock
4	3050-0066	8	2	Washer Flat
4	3050-0005	5	2	Washer Shoulder Fiber
4	3050-0003	3	4	Washer Flat Fiber
5	2110-0564	8	1	Fuseholder Body
5	2110-0565	9	1	Fuseholder Cap
5	2110-0569	3	1	Fuseholder Nut
6	03400-48301	0	2	Shock Mount Base
7	03400-69501	6	2	Shock Mount
$A2\Delta_2$	03400-66514	5	1	Impedance Converter Assembly
W4	03400-61603	3	1	Cable Assembly-Input Attenuator

Figure 7-4 3400A Bottom View with Shield Removed



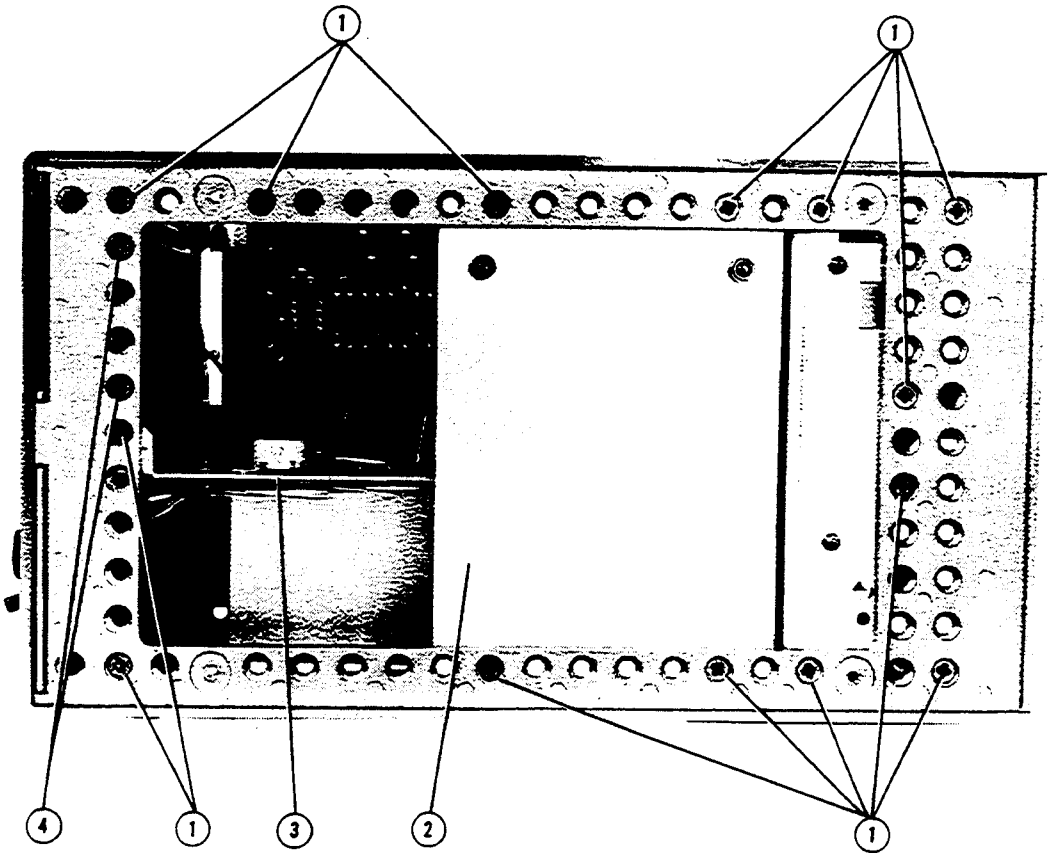
Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	0403-0126	7	2	PC Board Guides (Grey)
2	5020-0700	6	1	Spacer ⅓ Module
3	0590-0052	3	2	Nut Sheet Metal .5th
$A7\Delta_2$	03400-66515	6	1	Power Supply Board
4	03400-00215	5	1	Rear Panel
S2	3103-1234	3	1	Slide Switch.
J3	1251-2357	8	1	AC Power Connector
5	2110-0564	8	1	Fuseholder Body
5	2110-0565	9	1	Fuseholder Cap
5	2110-0569	3	1	Fuseholder Nut
J2	1251-0205	1	1	DC Out Jack

Figure 7-5 3400A Rear View



Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	2360-0316	7	12	Screw 6-32 .25 100 Deg. Pozi
2	2360-0121	2	3	Screw 6-32 .5 Lock Pozi
3	2390-0007	6	1	Screw 6-32 .312 Lock Slot
4	2360-0196	1	2	Screw 6-32 .375 100 Deg. Pozi
5	2360-0133	6	1	Screw 6-32 1.25 Pozi
5	2190-0007	2	1	Washer Lock Intl T
5	0900-0010	2	1	O Ring
6	03400-05502	3	1	Box Shield
7	03400-00602	4	1	Attenuator Shield
8	2360-0201	9	1	Screw 6-32 .5 Pozi
8	2190-0006	1	1	Washer Lock
8	3050-0066	8	1	Washer Flat
8	3050-0005	5	1	Washer Shoulder Fiber
8	3050-0003	3	2	Washer Flat Fiber
W2	03400-61601	1	1	Cable Assembly-Amplifier Input

Figure 7-6 3400A Left Side View



Index/Ref Number	-hp-Part Number	C D	Qty	Description
1	2360-0316	7	14	Screw 6-32 .25 100 Deg. Pozi
2	03400-04103	8	1	Transformer Mounting Plate
3	03400-00101	8	1	Chassis Main
4	2360-0196	1	2	Screw 6-32 .375 100 Deg. Pozi

Figure 7-7 3400A Right Side View

APPENDIX A
BACKDATING

A-1. INTRODUCTION

A-2. The following backdating information adapts this manual to instruments with a serial number prefix other than shown on the title page, but not below 2225 (see paragraph A-4). In addition, instruments where a serial number prefix change did not occur, are also listed in this appendix.

A-3. If the component values in the instrument are different than the ones shown on the schematics and parts list (Table 7-3) and are NOT listed in this appendix, replace with the component values and part numbers presently on the schematics and parts list.

A-4. The instrument serial number can be found on the rear panel of the instrument and is in the form of XXXXAXXXXX. The first four numbers is the serial number prefix and the last five numbers is the suffix. Refer to the following backdating information only if the prefix of your instrument is different than shown on the title page, and is 2225 and above. Instruments with a prefix below 2225 are older 3400A's to which this manual and the following information do not apply. For those older instruments, refer to a 3400A manual with -hp- Part Number 03400-90008.

A-5. MANUAL CHANGES

A-6. Refer to Table A-1 to adapt this manual to instruments with serial number prefixes or serial numbers below the ones shown on the title page. Make all the appropriate manual changes listed opposite your serial number or serial number prefix. Perform these in the sequence shown in the table.

A-7. If your instrument serial number or prefix is not listed on this manual's title page or in Table A-1, and the prefix is 2225 or above, it may be documented in a yellow MANUAL CHANGES supplement.

Table A-1. Manual Changes

Serial Prefix/Number	Make Manual Changes
2225	1, 2

CHANGE #1

This change applies to instruments with A6 Assemblies that have a Revision A designation.

Section V, Paragraph 5-22. Delete paragraph 5-22 steps a thru e.

Section VI, Figure 6-3 Changes. Use component locator in Figure A-1 and the schematic in Figure A-2. The shaded area on the schematic pertains to the changes.

Section VII, Table 7-3 Changes. Do the following changes in the table.

Reference Designator	-hp- Part Number	C D	Description
R621	0757-0280	3	Change to 1 K 1% .125W Resistor
R622	0698-3454	0	Change to 4.22 K 1% .125W Resistor
R625	0683-7545	0	Change to 750 K 5% .25W Resistor
R629	2100-3355	0	Delete 100K Potentimoter

CHANGE #2 (SERIAL No. 2225A30740 and BELOW)

The instruments with serial number 2225A30740 and below had different A2 and A7 Assemblies installed. Because the rear panel was also different, the instruments cannot be retrofitted for the new assemblies presently listed in Table 7-3. If any A2 or A7 Assembly needs replacement, use the old part number listed in Table A-2.

Section IV Changes. Change paragraphs 4-16 thru 4-18 to the following (use Figure A-3 with the paragraphs):

4-16. The impedance converter assembly utilizes a nuvistor cathode follower circuit to match the high output impedance of the input attenuator to the low input impedance fo the second attenuator. The cathode follower circuit preserves the phase relationship of the input and output signals while maintaining unity gain.

4-17. The signal input to the impedance converter is RC coupled to the grid of cathode follower V201 through C201 and R203. The output signal is developed by Q201 which acts like a variable resistance in the V201 cathode circuit. The bootstrap feedback from the cathode of V201 to R203 increases the effective resistance of R203 to the input signal. This prevents R203 from loading the input signal and preserves the high input impedance of the 3400A. The gain compensating feedback from the plate of V201 to the base of Q201 compensates for any varying gain in V201 due to age or replacement.

4-18. Breakdown diode CR201 controls the grid bias voltage on V201 thereby establishing the operating point of this stage. CR202 and R211, which are across the base-emitter junction of Q201, protects the transistor from +75 V power supply failures. Regulated dc is supplied to the V201 filaments to avoid inducing ac hum in the signal path. This also prevents the gain of V201 from changing with line voltage variations.

Section IV Changes. Add paragraphs 4-45/4-46 to the section (use Figures A-4 and A-5 with the paragraphs).

4-45. -6.3 Volt Supply

4-46. The regulated -6.3 volt supply consists of a full-wave rectifier (CR716 and CR717) whose output is filtered by C2 and regulated by Q3. Emitter follower Q705 is connected to the -17.5 volt supply which provides a reference for the -6.3 volt supply. Series regulator Q3 acts as a dynamic variable resistor in series with the output to oppose changes in the output voltage.

Section VI, Figure 6-1 Changes. Use component locator and schematic in Figure A-3.

Section VI, Figure 6-4 Changes. Use component locator in Figure A-4 and schematic in Figure A-5. The shaded area on the schematic pertains to the changes.

Section VII, Table 7-3 Changes. Do the changes in Table 7-3 as shown in Table A-2.

Table A-2. Changes in Table 7-3 (Change #2)

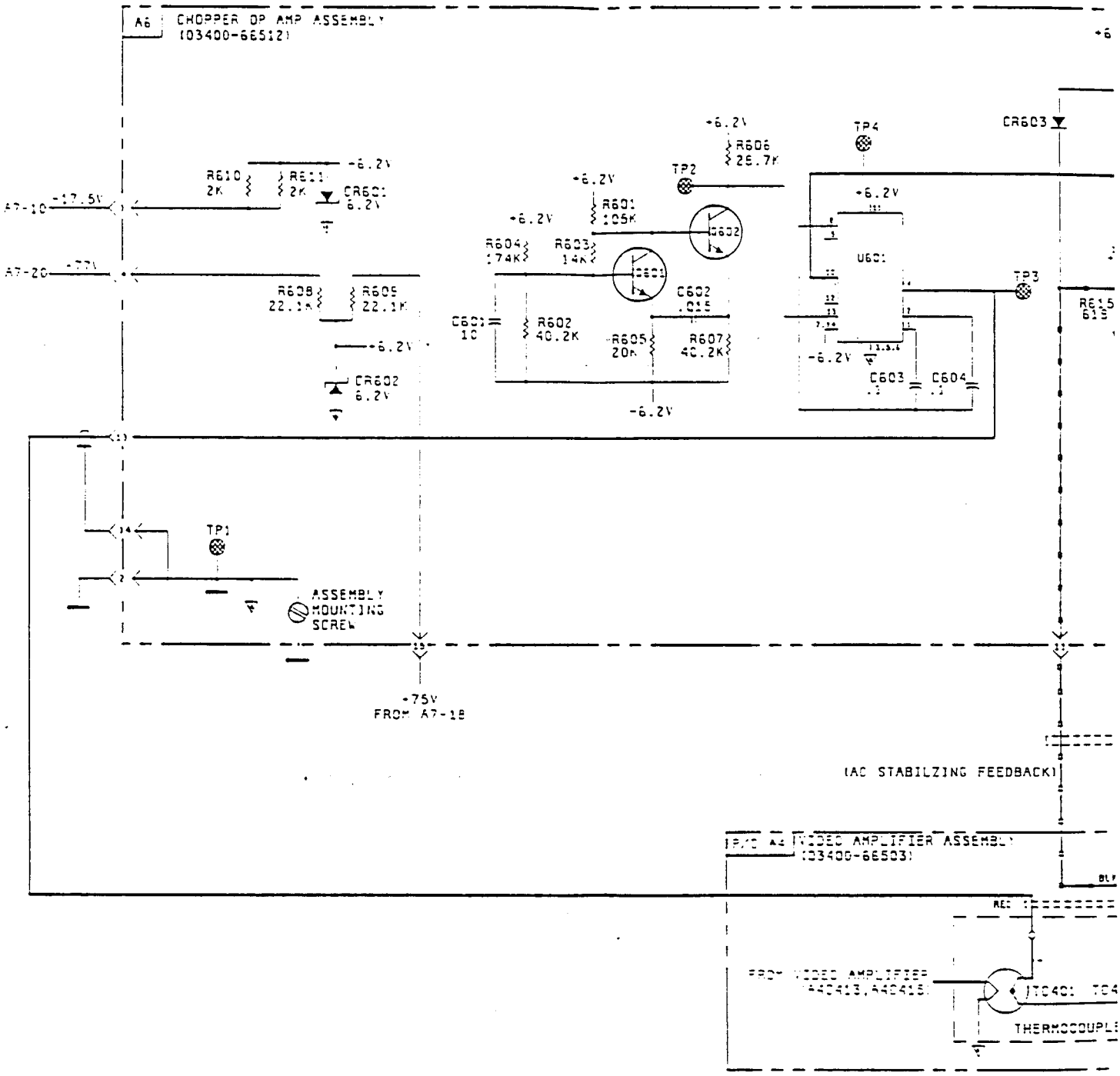
Reference Designator	-hp- Part Number	C D	Description
A2	03400-66502	0	Change Part Number
A7	03400-66513	4	Change Part Number
C2	0180-0148	9	Add 890 μF 15 Vdc Capacitor
C200	0160-0156	7	Delete .0039 μF Capacitor
C201	0160-2671	5	Change to .1 μF 80 Vdc Capacitor
C202	0150-0031	6	Change to 2 pF 500 Vdc Capacitor
C204	0180-0089	7	Change to 10 μF 500 Vdc Capacitor
C206	0140-0201	1	Add to 12 pF 500 Vdc Capacitor
C207	0180-0061	5	Add 100 μF 16 Vdc Capacitor
C208	0150-0024	7	Add .02 μF 100 Vdc Capacitor
CR201	1902-0045	1	Change to 7.32 V Zener Diode
CR202	1901-0025	8	Change Diode Part Number
CR203	1902-0964	0	Delete Ziner Diode
CR204	1901-0025	2	Delete Diode
CR205	1901-0025	2	Delete Diode
CR206	1901-0025	2	Delete Diode
CR716	1901-0045	6	Add Diode
Q3	1853-0311	6	Add PNP Transistor
Q201	1854-0215	1	Change to NPN Transistor
Q202	1854-0009	1	Delete NPN Transistor
Q705	1854-0215	1	Add NPN Transistor
R200	0683-2225	3	Delete 2200 Resistor
R201	0683-3935	4	Change to 39 K 5% Resistor
R202	0683-4715	0	Change to 470 5% Resistor
R203	0683-3355	2	Change to 3.3 M 5% Resistor
R204	0683-1035	1	Change to 10 K 5% Resistor
R205	0683-8225	5	Change to 8.2 K 5% Resistor
R206	0683-8215	3	Change to 820 5% Resistor
R207	0757-0848	9	Change to 30.1 K 1% Resistor
R208	0683-2715	6	Change to 270 5% Resistor
R209	0683-1015	7	Change to 100 5% Resistor
R210	0698-4125	7	Delete 953 1% Resistor
R211	0683-2725	8	Change to 2.7 K 5% Resistor
R212	0757-0136	5	Add 5.03 K 1% Resistor
R213	0757-0126	3	Add 3.266 K 1% Resistor
R707	0683-1505	0	Delete 15 5% Resistor
R708	0683-2405	1	Change to 24 5% Resistor
R730	0698-4477	2	Add 10.5 K 1% Resistor
R731	0757-0200	7	Add 5.62 K 1% Resistor
R732	0683-2825	8	Add 2.7 K 5% Resistor
V201	1921-0017	4	Add Electron Tube
XV201	1200-0086	9	Add Tube Socket

Section VII, Figure 7-2 Changes. Do the following changes in the table located in Figure 7-2.

Index/Ref Number	-hp- Part Number	C D	Description
A7	03400-66513	4	Change Part Number of Power Supply
6	03400-00102	9	Change Part Number of Rear Chassis
T1	9100-4348	9	Change Part Number of Transformer

Section VII, Figure 7-4 Changes. Change the part number of the A2 Assembly from "03400-66514" to "03400-66502".

Section VII, Figure 7-5 Changes. Change the part number of the A7 Assembly from "03400-66515" to "03400-66513".


A6 CHOPPER OP AMP ASSEMBLY
(03400-66512)
R610 2K
R611 2K
CR601 6.2V
+6.2V
+17.5V
A7-10
A7-20
R608 22.1K
R609 22.1K
CR602 6.2V
R606 25.7K
TP2
R601 105K
Q602
R604 174K
R603 14K
Q601
C601 10
R602 40.2K
C602 .015
R605 20K
R607 40.2K
-6.2V
TP4
CR603
U601
TP3
C603
C604
TP1
ASSEMBLY MOUNTING SCREW
+75V FROM A7-18
(AC STABILZING FEEDBACK)
VIDEO AMPLIFIER ASSEMBLY
(03400-66503)
THERMOCOUPLE

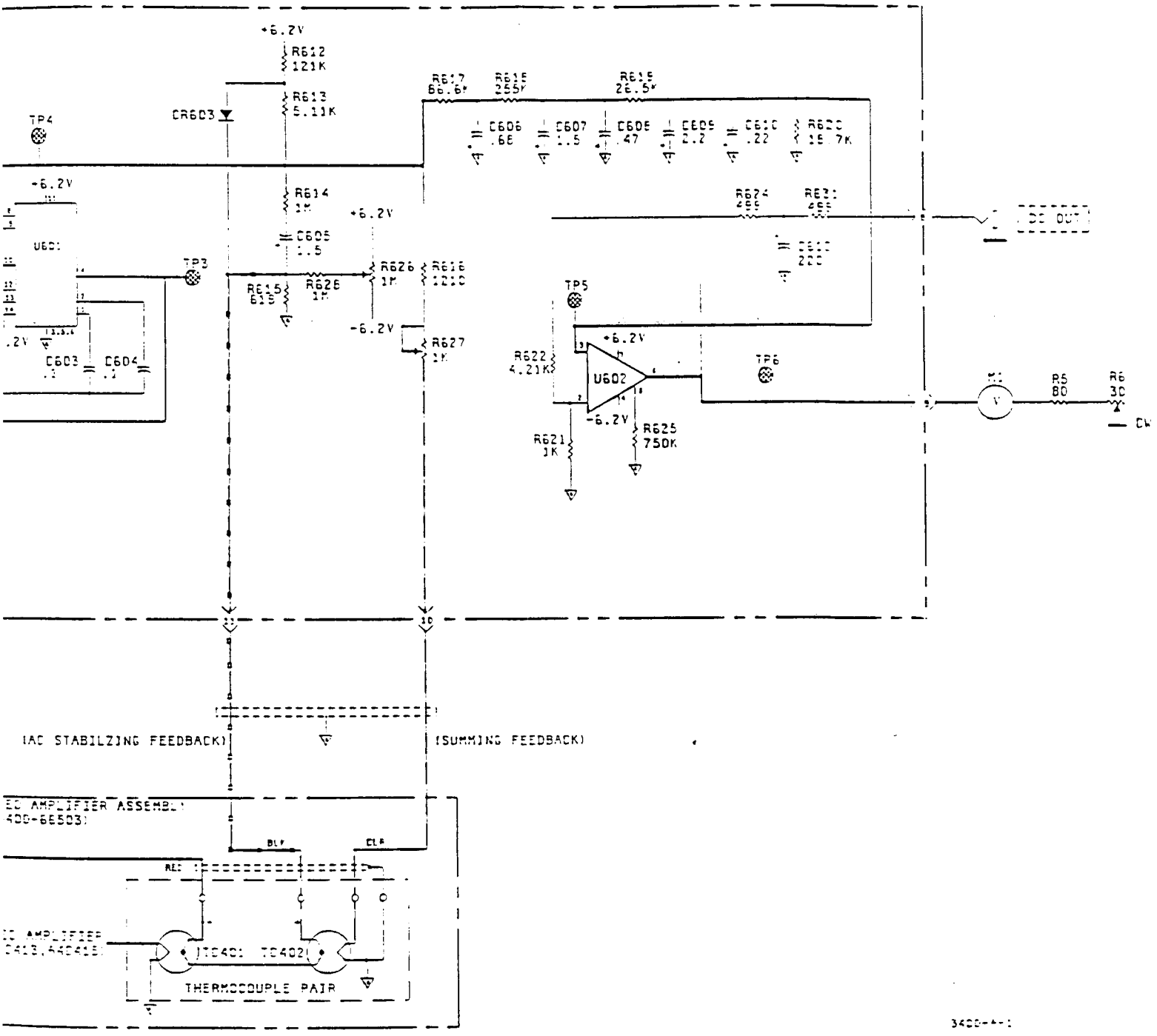
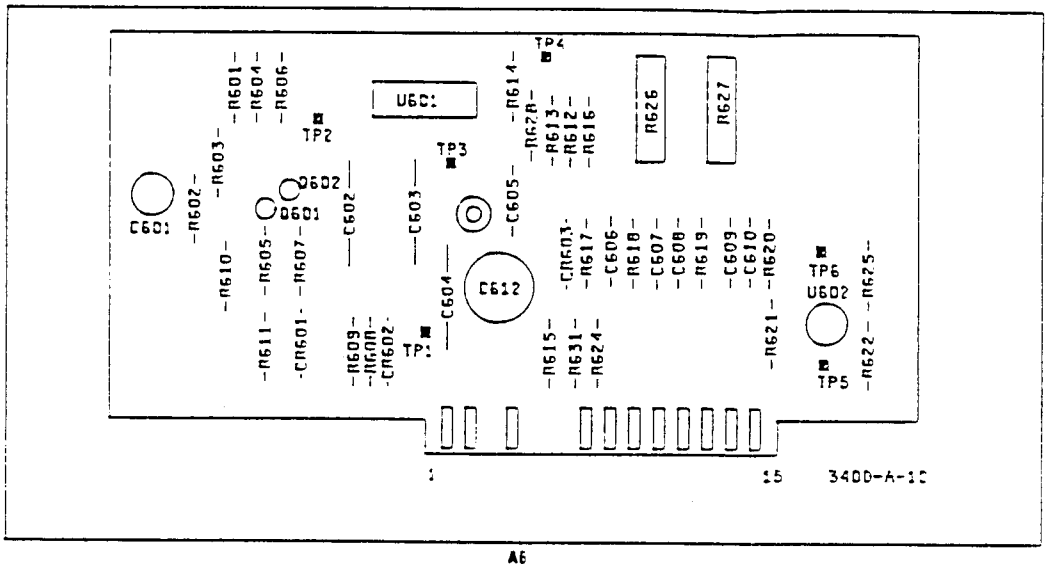
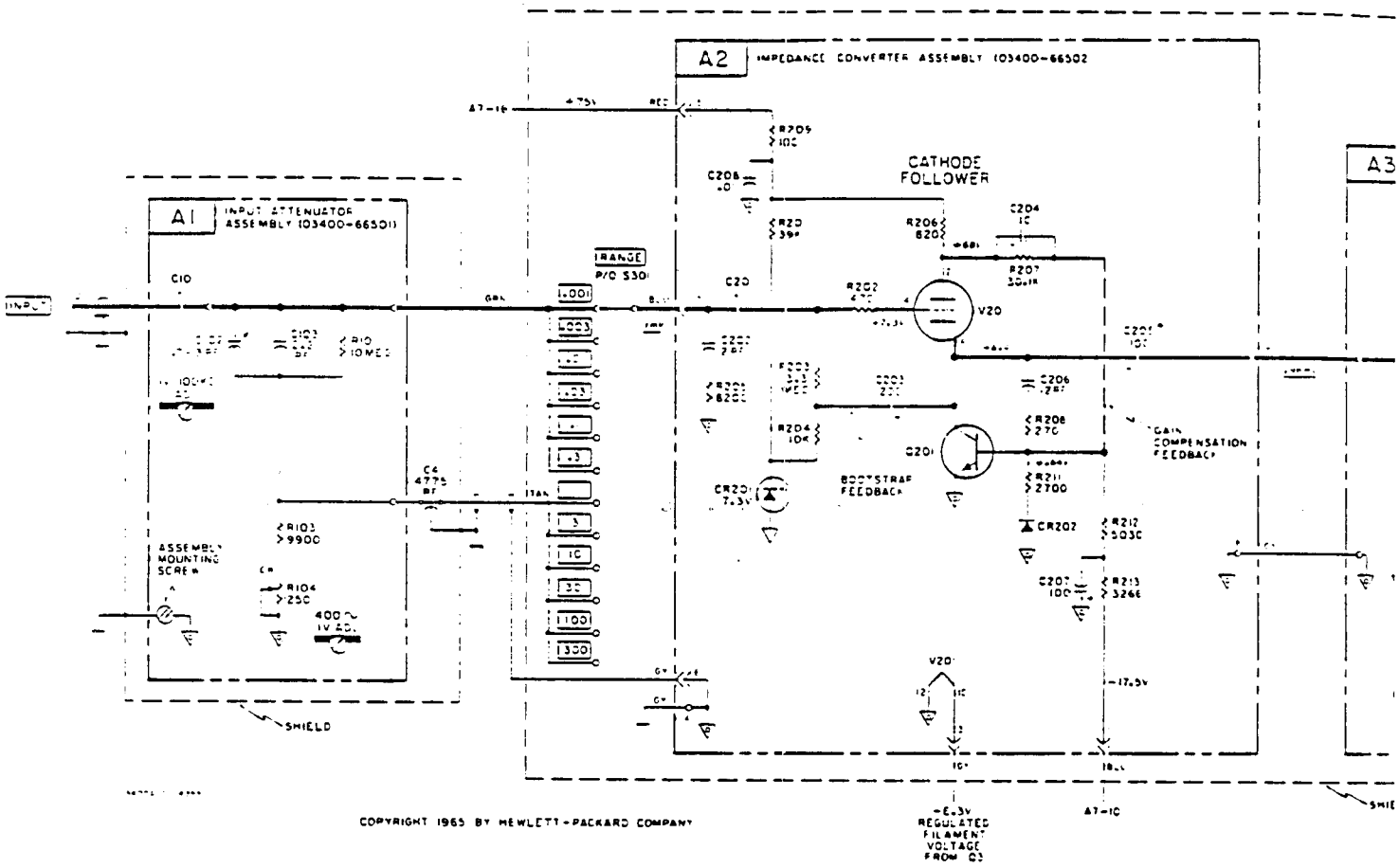


Figure A-2. Figure 6-3 Schematic (Change #1)



A6
(Rev.C)
(-hp- Part Number 03400-66512) Δ1

Figure A-1.
Figure 6-3 Component Locator Changes (Change #1)



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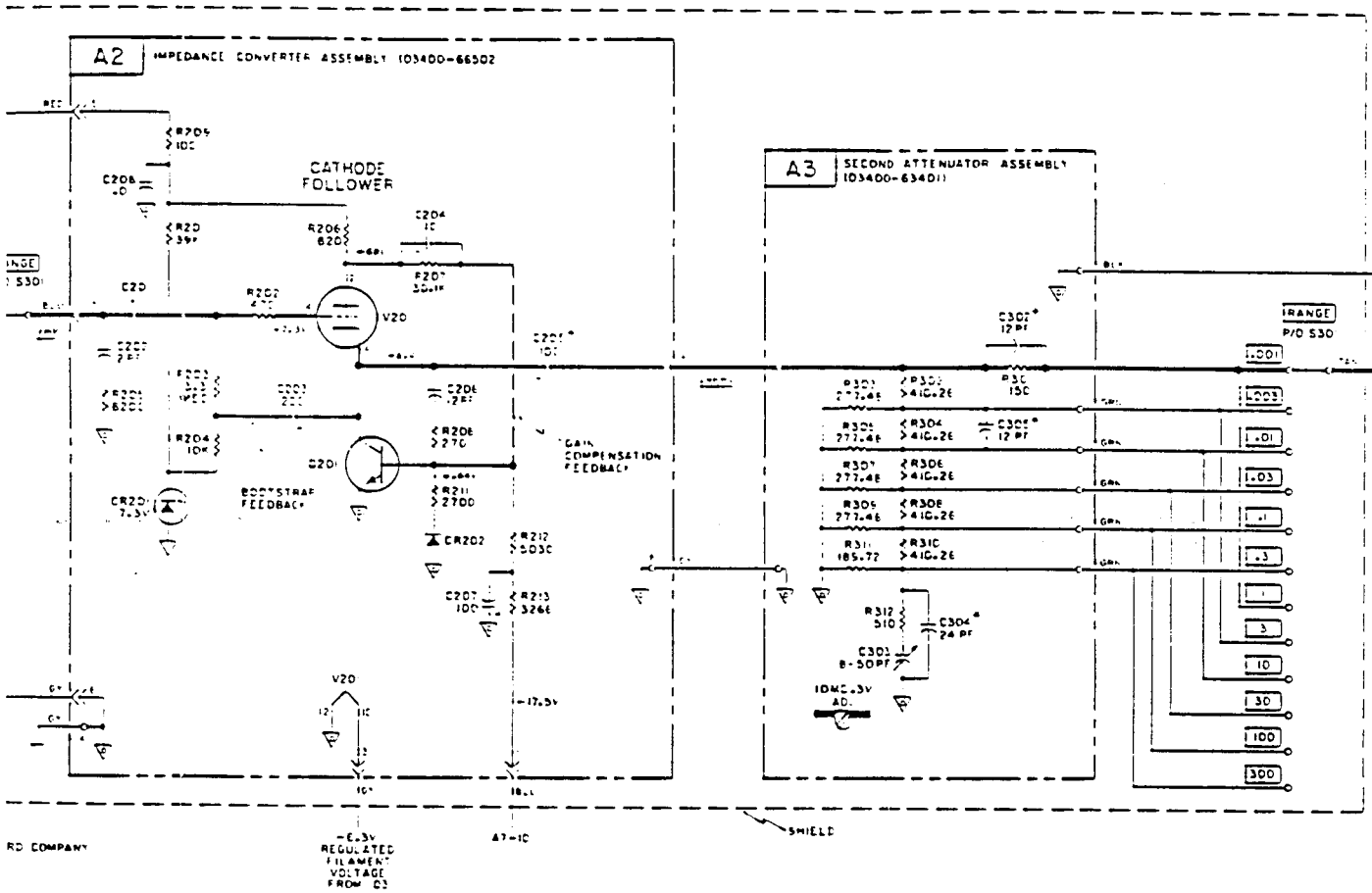
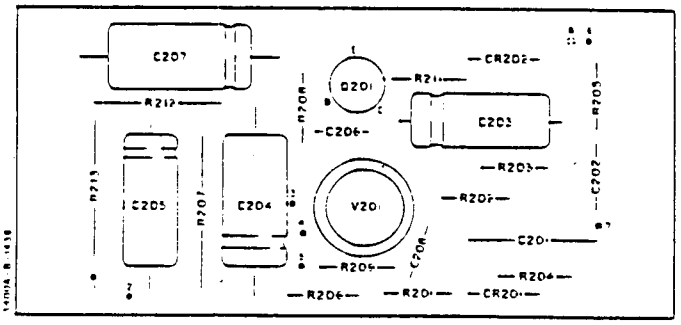
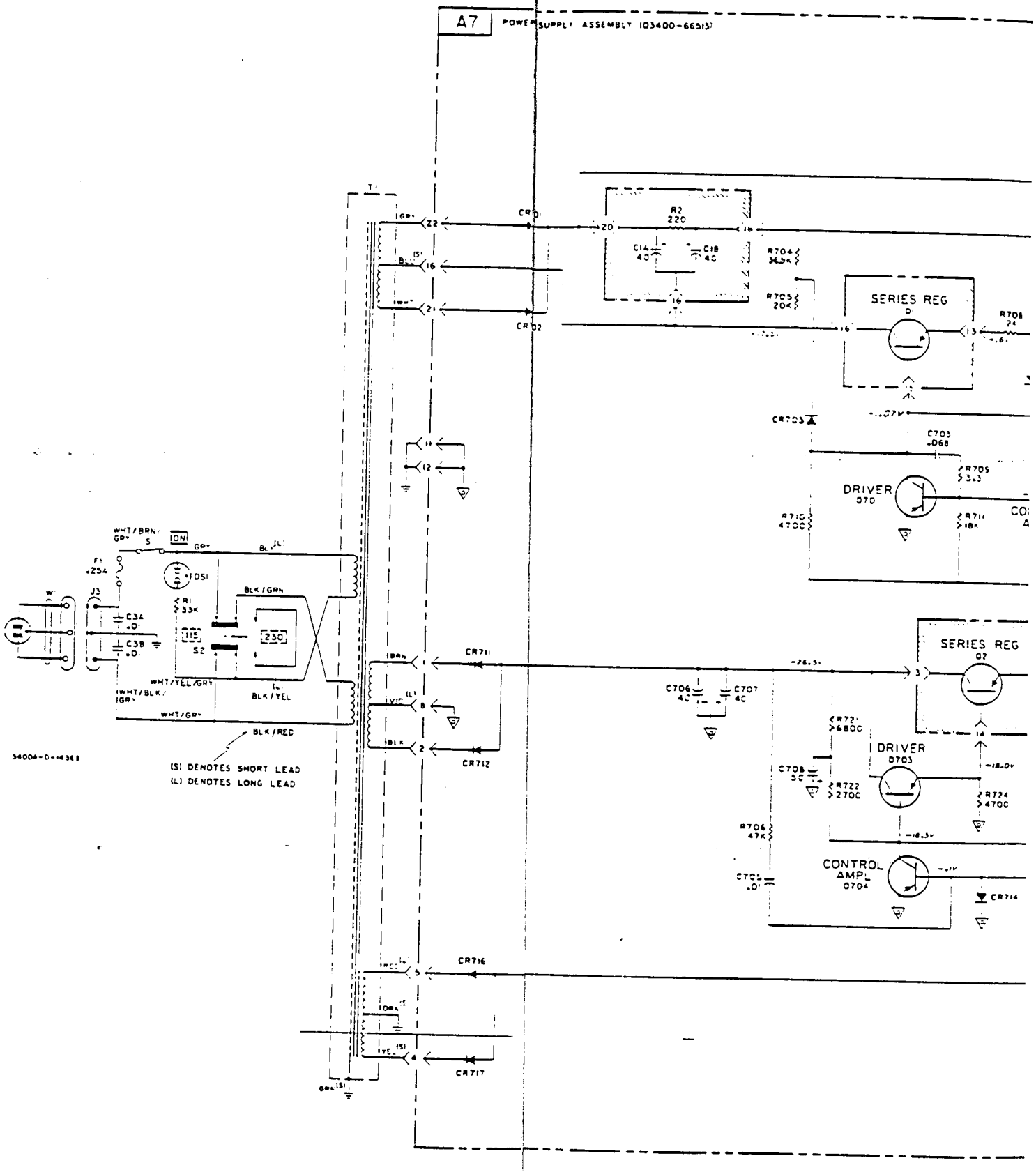




A2
(Hp Part Number 03400-66502)

Figure A-3. Figure 6-1 Changes (Change #2)


A7
POWER SUPPLY ASSEMBLY (03400-66513)
SERIES REG
Q1
DRIVER
Q703
CONTROL AMPL
Q704
SERIES REG
Q
DRIVER
Q70
R2
220
C14
40
C18
40
R704
36.5K
R705
20K
R708
74
C703
.068
R709
3.3
R710
4700
R711
18K
CR703
CR702
CR710
CR711
CR712
CR716
CR717
CR714
C706
40
C707
40
R721
680Ω
C708
5C
R722
270Ω
R724
470Ω
R706
47K
C705
.01
-76.5V
-18.0V
-18.3V
-.07V
-.67V
W
J3
F1
.25A
C3A
.01
C3B
.01
R1
33K
S2
115
230
DS1
ON
S
WHT/BRN
GRY
GRY
BLK (L)
BLK/GRN
WHT/YEL/GRY
WHT/BLK
(GRY)
BLK/YEL
WHT/GRY
BLK/RED
34004-D-14368
(S) DENOTES SHORT LEAD
(L) DENOTES LONG LEAD

Figure

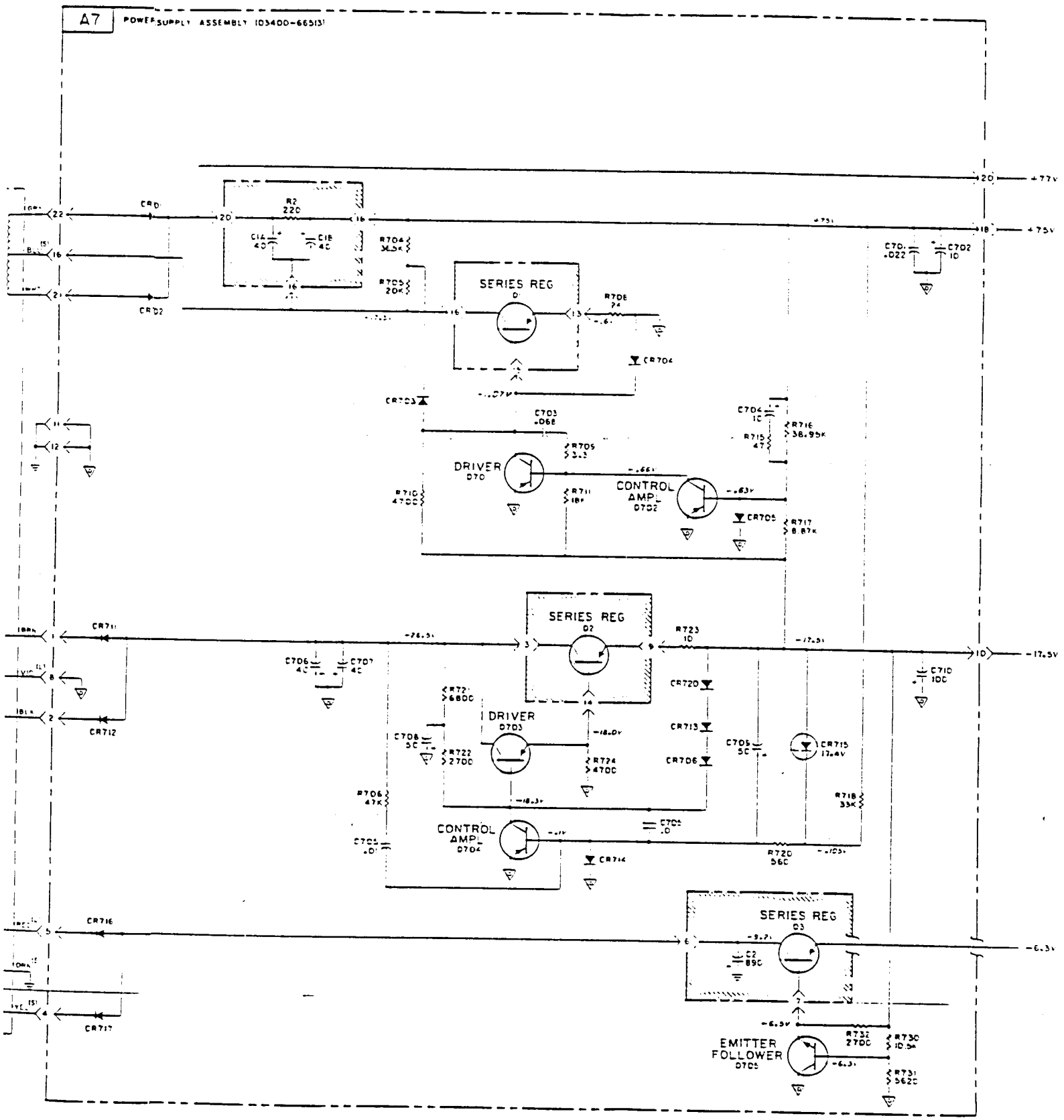
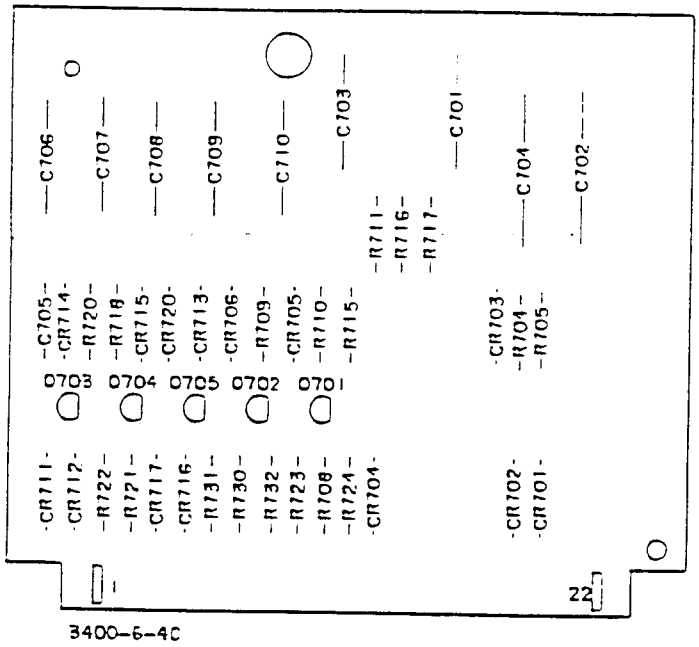


Figure A-5. Figure 6-4 Schematic Changes (Change #2)



A-7
(03400-66510)

Figure A-4.
Figure 6-4 Component Locator Changes (Change #2)